ON THE COVER

OUR cover picture shows a Hillman-Kelley air-powered tong or wrench being used to screw together sections of tubing being run into a California oil well. Other pictures and a description of this much-used, time-saving tool appear on Page 56.

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IN THIS ISSUE

PRIOR to the present century all well drilling was done by alternately raising and dropping a chisel-like bit suspended at the end of a cable. The Chinese are reported to have used the first of these rigs 2000 years ago to obtain brine, their source of salt. Sometimes a well yielded natural gas, which served as fuel to evaporate the brine. Occasionally a well struck oil, which was then of value only as a lubricant. Cable rigs drilled all America's oil wells for 40 years and still drill about a third of them. However, in 1901, following experiments in water-well drilling in the Dakotas, a new and faster-acting apparatus appeared. It provided a means of rotating a pipe having a cutting bit at its lower end.

Today, some 3000 rotaries are operating in the United States. On the larger rigs, human muscles can no longer cope with tasks traditionally assigned to them, so mechanisms are replacing them. Consequently, crews now have things easier and holes go down faster. Compressed air looms large in these new facilities, both as a means of exerting precise control over numerous rig functions and as power for certain operations. Our first article tells the story of the oil-well driller's dependable new helping hand.

●

BEFORE the end of the month, Canada is expected formally to annex Newfoundland, Britain's oldest colony. Almost since its discovery in 1497 by John Cabot, "New Founde Island" has been peopled by spirited, resolute folk who have had the hardihood to battle stern natural forces and meanwhile maintain their independence. Now, after 450 years, a vigorous nationalism has bowed to economic necessity. Included with the island is Labrador, almost unpopulated but potentially rich in minerals. Much will be heard in the future from this new province. Page 61.

●

EVEN though paper is known to be an extremely adaptable material, it is doubtful whether many persons are aware that it makes highly acceptable pulleys that are widely used for transmitting power. It is a fact, however, that such pulleys are the principal product of a large plant in Indiana. Page 66.

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EDITORIAL CONTENTS

ADVERTISING INDEX

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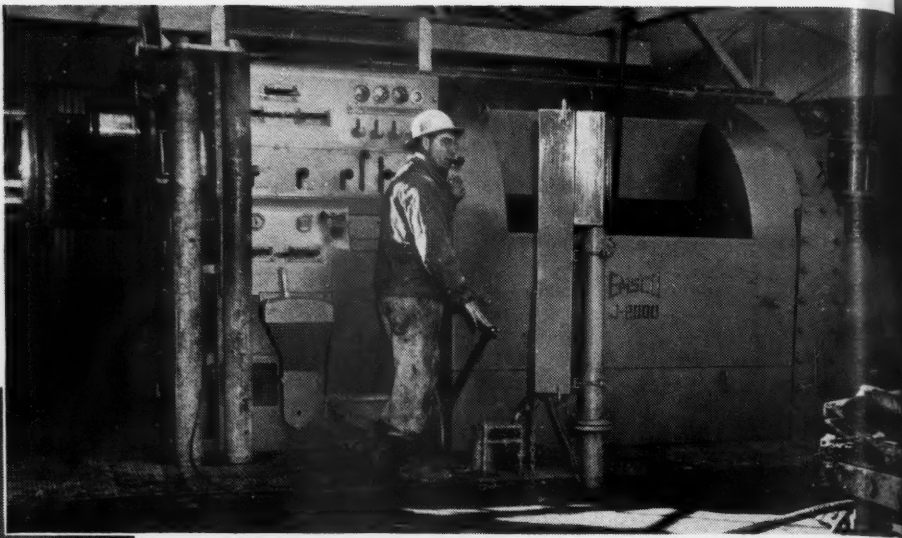
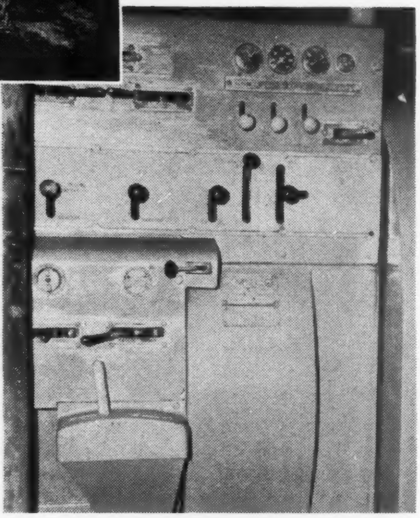
OPERATING PIPE RETAINERS

The driller at his control station, right, depresses two small pedals (close-up below) to admit air to or exhaust it from the plunger mechanism that handles the slips (shown on opposite page). This almost effortless maneuver accomplishes work that would otherwise tax the strength of two strong men. Behind the driller is the control panel with its levers and knobs that permit fingertip operation of the various elements of the drilling cycle.



Compressed Air— New Oil-Field Roughneck

Elton Sterrett



CONTROL PANEL

Close-up of compact grouping of controls for operating pumps, drawworks, and rotary engines and for providing selective speeds in the transmission units. Gauges at the top-right show air pressures on the controls and in the storage tanks.

IF THE men that make up the crew of a rotary drilling rig had developed as much in the past half century as the mechanical equipment they use to drill oil wells, the roughneck[1] of today would be approximately 11 feet tall, 4 feet 7 inches across the shoulders, weigh in the neighborhood of 1100 pounds, and clump around in Number 30 shoes. That they could not keep pace is, of course, due to the innate limitations of *homo sapiens*, who fortunately has brains enough to create machines to take the load off his shoulders when it becomes too heavy.

Despite outstanding improvements in power-driven equipment, the tool-pusher or driller sizing up a "boll weevil" or raw hand as late as the middle of the last decade was forced first to consider the broad back and sinewy thighs of the applicant and then—if at all—his mental aptitude. For by 1940, with ever-deepening holes, the pipe to be handled at each trip of the drill string into and out of the well made physical demands on the men far exceeding those imposed upon the star back on a professional football team.

Among companies with well-planned retirement policies, the problem of what to do with drilling-crew members when they become too old to stand up under the demands of the rig-floor job is a major one. The man trained to operate or perform any of the many tasks involved is not qualified for any other oil-field work, nor is he inclined, after enjoying drill-crew pay, to accept a pick-and-shovel or watchman's assignment on public works where floating or common labor is used.

The man between the ages of 40 and 50, with 20 to 30 years of drilling experience behind him, has a fund of practical knowledge that is of great potential value to his employers, who helped him to acquire it, if he can be continued on the job when his muscles begin to sag under the strain. If equipment can be found to do the heavy work, his training enables him to improve upon the drilling technique for many years after his body has to lay down the task.

One of the back-breaking chores performed manually by a drilling-rig crew is that of lifting the slips or retainers used to hold the string of drill pipe in the rotary table when the joint is made or unscrewed. For example, when withdrawing pipe from a 11,000-foot well to lay it down, the men handling the slips move the equivalent of 24 tons of steel vertically from a point below toe level to a height above their knees. This extended "lift" is made when the clamping de-

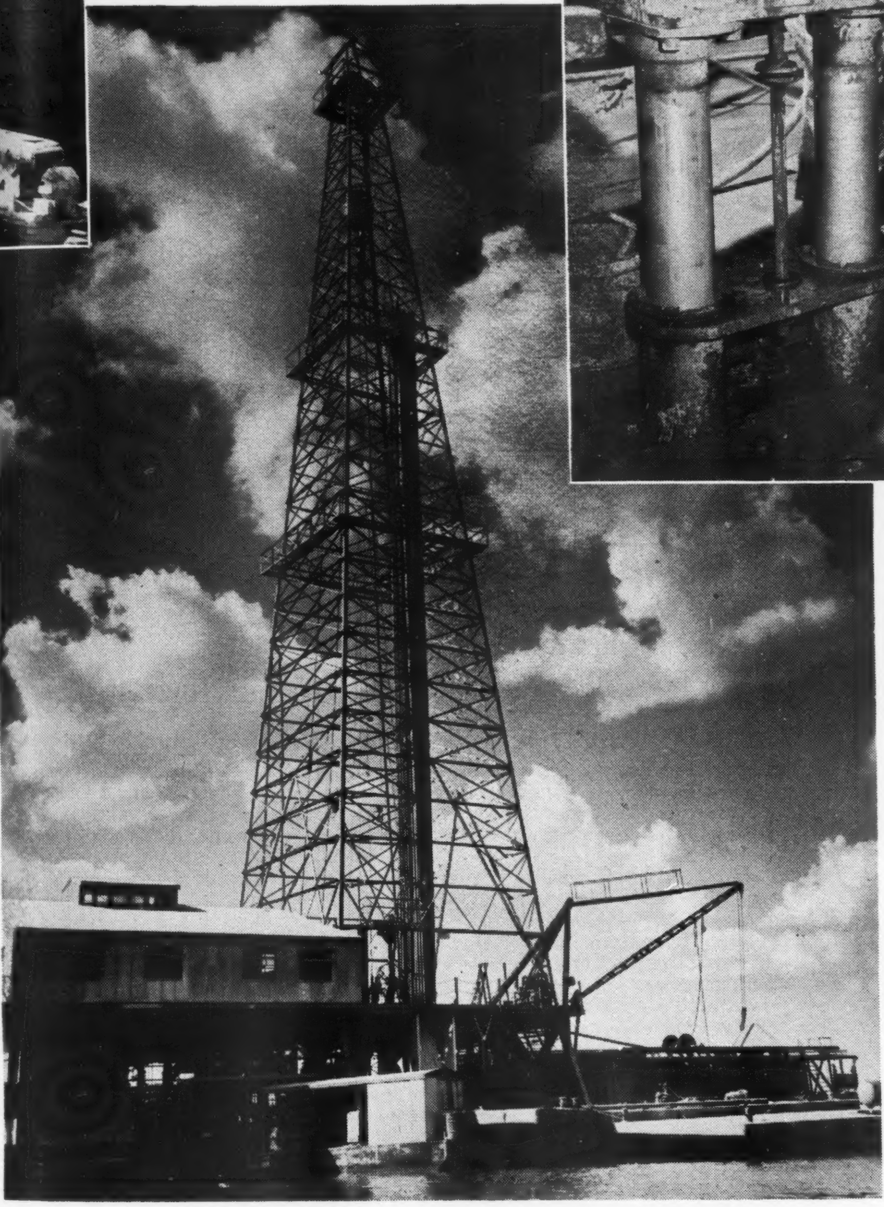
Uses of Compressed Air on Drilling Rig

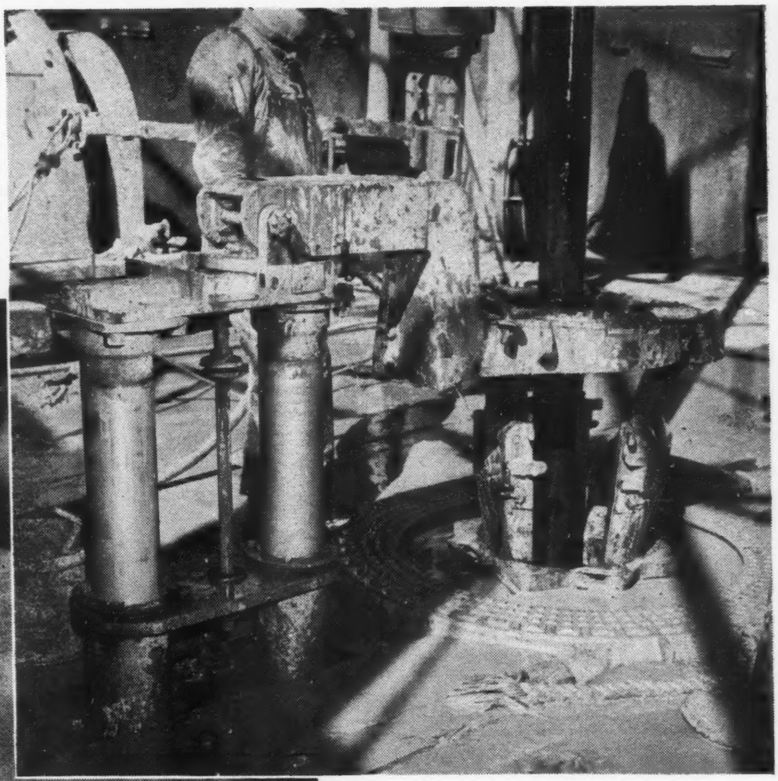
- Operating auxiliary rig-floor hoists
- Operating automatic-tubing, casing, and drill-pipe tongs
- Operating remote controls on rotary table, mud pump, and sand-line units
- Operating automatic slips, both drill-pipe and casing
- Operating pneumatic clutches and shifts on drawworks
- Controlling drilling engines
- Operating impact wrenches for maintenance of mud pumps, blow-out preventers, and engines
- Starting internal-combustion engines
- Dewatering excavations for foundation piers
- Flowing water wells
- Purging auxiliary pipe lines before dismantling them preparatory to moving rig
- Furnishing power for pumps operating blow-out preventers
- Controlling mud-line flow
- Operating rock drills for digging sumps

[1]Roughneck, oil-field term for the musclemen of a drilling crew, as distinct from the "brains" or directive men. The term is unknown to Webster, Merriam, etc., in its oil-field sense.

DEEP-WELL RIG

With its derrick towering nearly 200 feet above the water, the barge-mounted marine drilling rig of Shell Oil Company, Inc., below, houses equipment too massive to be operated manually, so air power supplants human muscles at the controls and also does some of the lifting jobs.





PNEUMATIC MUSCLES

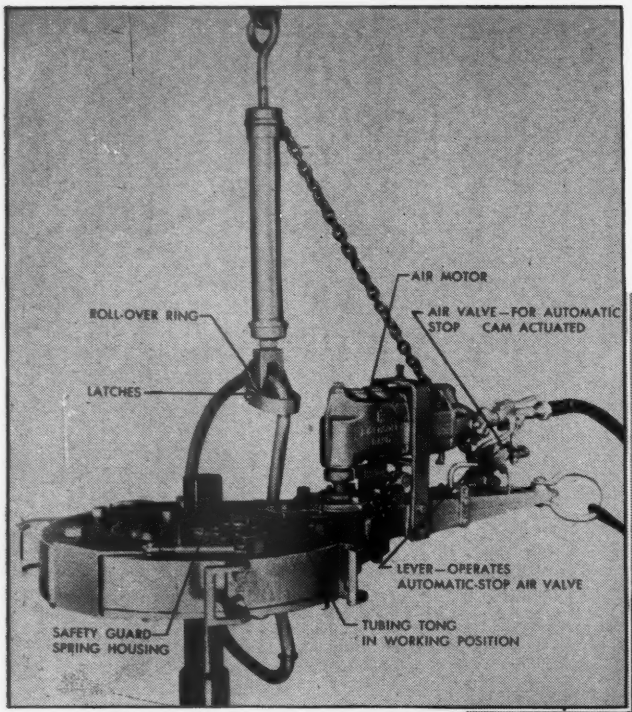
When drill pipe is being run into or withdrawn from a well, it is assembled or taken apart in sections, each of which must be screwed or unscrewed. While this is being done, the string in the well is prevented from dropping by inserting wedgelike slips or retainers in the rotary table to hold it. Lifting or lowering of the string is done by drawworks. When the latter takes over the load, the slips release their clamping grip and are then pulled up and moved aside until needed again. This operation, which involves the lifting of many tons repeatedly, is a back-breaking manual task that has now been taken over on many rigs by air power. In the view above, the drill pipe is coming out of the hole. Simultaneously, the retainers are being raised and withdrawn by a hinged arm extending from the tops of two plungers working in air cylinders at the left. Once above the floor level, the slips are swung clear of the pipe. The upward travel of the plungers is limited by the vertical rod between them.

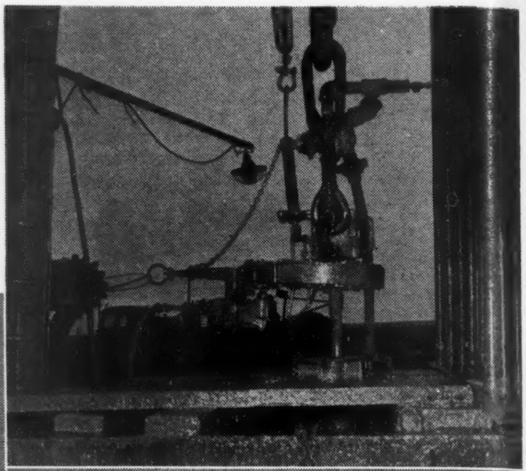
vice is pulled from the table and set aside to allow the rig hoist to move the pipe, operations that are repeated some 300 times.

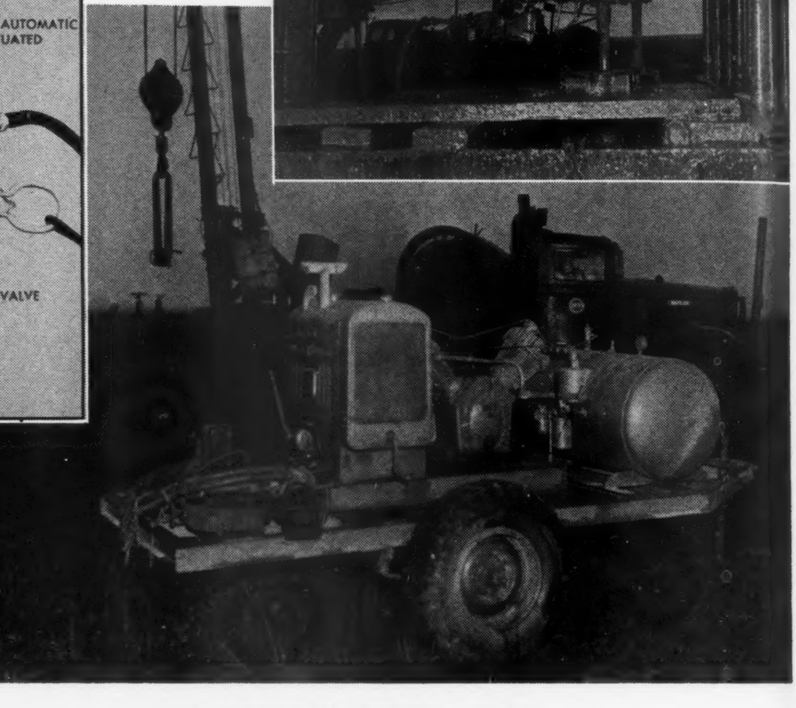
Efforts to use compressed air for the handling of the retainers have succeeded in relieving the men of this heavy work and have placed it on a compressor which, under pedal or lever control by the driller, is faster and more accurate and does not become "fatigued" like the drill crew. In operation, the driller admits air at 150 psi., gauge, to cylinders carrying a hinged arm from which are suspended three slips, each on a guided toggle joint. With the cylinders under pressure, the upward force exerted by them is not enough to withdraw the slips from the tapered table bushing in which they seat so long as the weight of the drill string, still in the hole, is borne by them. But as soon as the string starts upward under the lift of the drawworks, or hoisting unit of the rig, the load on the retainers is removed and the air pressure raises the arm to the limit of its travel, allowing the slips to swing clear and leave the table bushing unobstructed for the passage of the pipe. The slips are reset by exhausting the air from the cylinders, allowing the jaws to slide down into the tapered bushing until they are locked by wedging around the pipe string.

With air-operated slips, the only task the crew must perform manually is that of attaching a hoisting line to the hinged arm to rotate it into or out of position along the top of the cylinder tie member. Beyond that, the driller controls the retainers as he runs the hoisting unit, and he can synchronize their motion and that of the pipe much better alone than when the setting must be done by two or three men working separately.

As wells penetrated ever deeper into the earth, and as drawworks were designed to meet the increasing loads, the simple jaw or step clutches that once







sufficed for gear-changing and controlling the winding speed of the hoisting-line drum became outmoded. The weight of those clutch members became such that intricate lever systems were needed to enable one man to shift them even under favorable temperature conditions. And when cold weather added its quota to the drag, clutching and declutching wore down a driller long before his 8-hour tour was finished.

AIR-OPERATED TUBING TONG

In making up or disconnecting screwed sections of tubing being run in or out of wells, a power tong saves valuable time. The Hillman-Kelley tong pictured here and also shown on our cover is now used the world over. Power supplied by an Ingersoll-Rand reversible air motor rotates the tubing at 48 rpm., and the average time of adding a section to the string is twenty seconds. Uniform tightening of all joints is assured. In breaking a joint, a turning force or torque of 3620 foot-pounds is exerted in low gear. After one turn has been made, a shift to high gear speeds up rotation. Air consumption averages 17 cubic feet per joint at 80 psi. pressure. Tongs of larger sizes are being developed for handling drill pipe. At the top-right is shown a tong gripping tubing that is being removed preparatory to cleaning a well. Component parts of a unit are illustrated in the view at the top-left. Directly above is pictured a workover rig made by M & R Specialty Company of Houston, Tex., and stationed alongside a well seen in the background. In the foreground is a trailer-mounted compressor that serves to supply air to the Hillman-Kelley tong shown, together with its air hose, on the left end of the trailer. The outfit was assembled by the Holders Equipment Company of Houston. It includes an Ingersoll-Rand compressor driven by a Hercules gasoline engine. To insure clean oil-saturated air for operating the tong, the discharge from the storage tank passes through a Norgren filter and lubricator.

Air-powered clutches, actuated by finger-operated levers or push buttons instead of massive pedals and ponderous push rods, have been assigned the task of controlling shaft rotation. Now the driller can change gears with less manual effort than a truck driver exerts on his lever gear shift. Interlocking controls, simple and foolproof, eliminate the possibility of careless or accidental contact with the control panel and consequent release of the load by the driving unit. Air clutches work without shock, thus greatly extending the service life of chains, gears, and other components of the drawworks drive. They also save much time, as against manual operation. On one run, in which a string of pipe was pulled from a well 15,000 feet deep, it was computed that air-powered clutches saved 30 minutes, which gain took no account of the greatly improved physical condition of the driller at the end of the long job.

In the maintenance of mud pumps and drilling engines, it is frequently desirable to remove the heads of either the power or working cylinders, as well as those over valves. Today, an air-powered impact wrench, provided with sockets to fit standard sizes of nuts, does this work in place of the box wrench and sledge. Thus one man can remove and apply nuts much faster than the two that are needed by the old method. Because the impact wrench distributes the force equally around the studs, as compared to the shock of sledge-hammer blows, it adds much to their service life and thus lessens the danger of service interruption. Easily reversible, the tool can be used in spaces that admit the box wrench and sledge, and it requires no back-up because of its balanced construction and the absence of any torque reaction on the operator.

Where the formations penetrated by a drill bit are of a nature to deposit abrasive grit in the mud stream, it is the practice to rotate maintenance so that only one part of a mud pump, for example, needs attention at any one time. The general cycle for such work is a month or four weeks, during which all piston rubbers and valve seals are changed or checked.

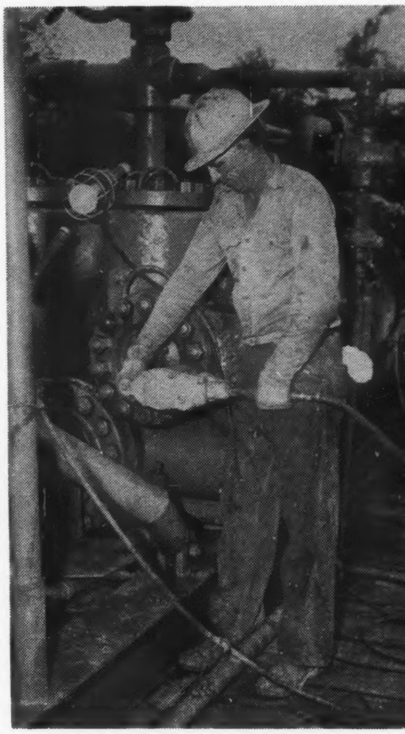
An air-powered auxiliary hoist, set on the rig floor alongside the rotary table and behind the rathole[2], has been substituted for the cathead (capstan) and

[2]In drilling-rig language, the rathole means a 40-foot length of 8- or 10-inch pipe set vertically in the ground close to the rotary table. When the elevators are to be used to pick up a length of pipe that is to be added to the string in the hole, the kelly, which is ordinarily suspended from the elevators, is disconnected and lowered into the rathole. Because the kelly's swivel is too large to enter the pipe it rests on top of it.

OIL and gas-well drilling in the United States now totals considerably more than 100 million feet of hole annually. Although four out of five wells are still less than 5000 feet deep, 12,000- and 15,000-foot holes are common, and several have been put down close to 18,000 feet. In two producing areas—Mississippi and southern Louisiana—more than one-third of the wells drilled exceed 10,000 feet.

Drilling rigs designed to reach depths of 20,000 feet are now in service. On these new and costly power plants, which range up to 2000 hp., compressed-air controls operated by levers or push buttons relieve the driller of virtually all muscular exertion and permit him to concentrate on the important job of directing the work. Air power is fast taking over traditional back-breaking jobs on new and older drilling rigs alike. It not only eases the burden on the crews but also saves valuable time on an operation where minutes fast run into dollars.

The accompanying article describes some of the principal roles now played by compressed air, a highly adaptable and instantly responding drill hand.



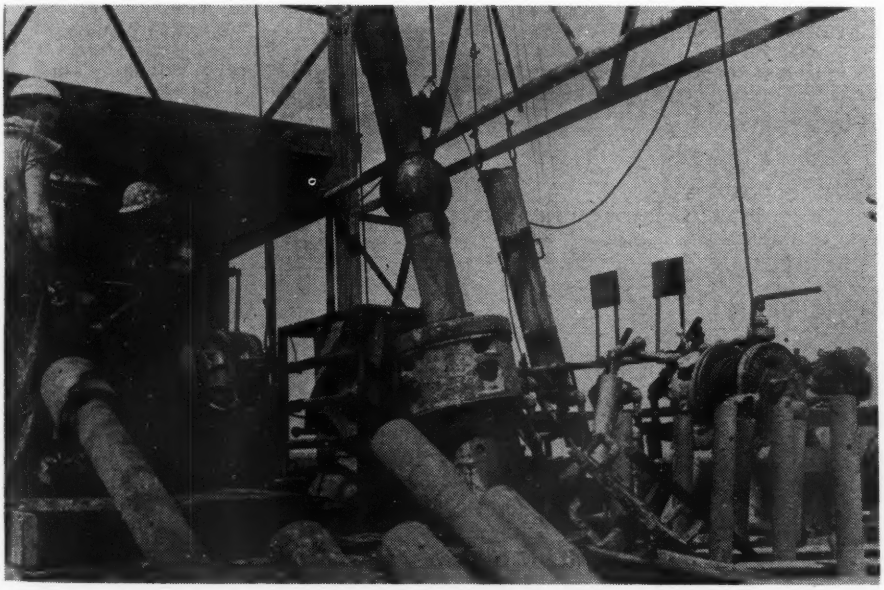
TIME-SAVING WRENCH

An Ingersoll-Rand close-quarter, reversible impact wrench is shown here removing nuts during maintenance work on a mud pump. The tool will operate in any position, is many times faster than the box-wrench-and-sledge method, and does not damage nuts, bolts, or studs. The size illustrated—the No. 538—will handle nuts on bolts up to 1½-inch diameter.

catline for such jobs as lifting drill pipe into the mousehole[3], setting up and moving equipment on the rig floor, securing bits, and shifting the kelly to one side to clear the rotary table. This hoist, with a sand line[4], usually 6x19 Seale, handles anything that a catline can move. Its use effects marked savings in operating cost because one catline is now good for several wells instead of having to be renewed every few thousand feet of hole. One operator found that his catline was still practically new when drilling below 10,000 feet.

Considerable quantities of water are used in drilling an oil well. It is needed on all rotary rigs to keep the circulating drilling mud at the proper consistency. If steam is the power medium, the boilers will require upwards of 1500 barrelfuls daily. In locations where no water supply has been established, it is customary to drill an independent well of small bore to tap an underground source, an adequate amount ordinarily being obtained by going down no more than a few hundred feet. During the drilling campaign the well may provide water for several rigs, but it is generally capped after it has served its purpose in order that it can be tapped in after years when oil wells are to be reworked.

The water is usually made to flow by the air-lift method—that is, by introducing compressed air at or near the bottom of the column of water to lighten it and boost it to the surface. This "blowing," as it is termed in oil-field parlance, is an important application of compressed air around a drilling rig.



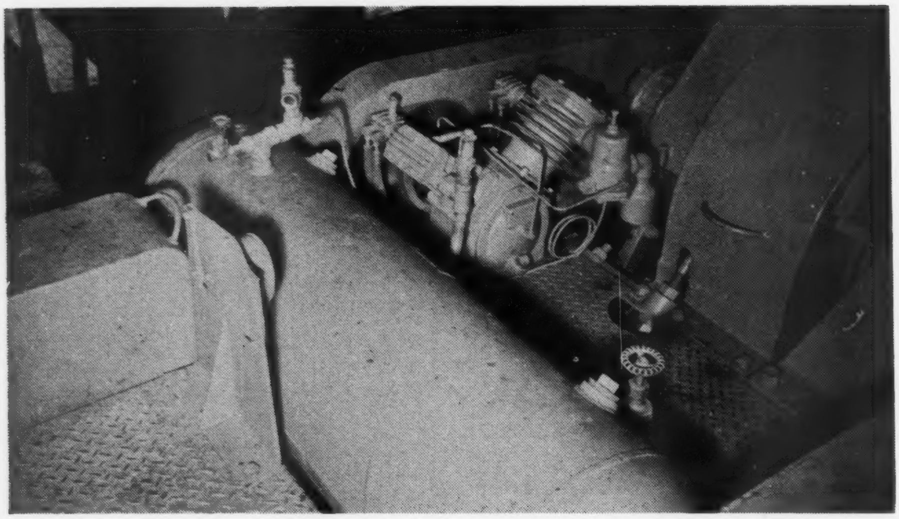
HOIST IS KEPT BUSY

Various lifting and moving jobs traditionally handled by wrapping a line around a cathead or capstan are now done quicker, safer, and cheaper with air-operated hoists. The Ingersoll-Rand, single-drum Utility hoist shown at the right exerts a rope pull of 2000 pounds at a pressure of 80 psi. and holds sufficient cable to snake in drill pipe from the storage rack adjacent to the derrick as needed to lengthen the string in the hole. Using only one hand, the operator can control the speed of lifting or lowering at all times and can brake the load to stop and hold it steady wherever desired. Ordinarily, two men are required to handle a cathead line safely and effectively. If compressed air is not available, the Utility hoist can be operated with gas pressure or fitted for operating with steam.

Many of the newer rigs that are designed to put down wells to depths of 10,000 to 20,000 feet are powered by gas or diesel engines, multiple units being arranged to supply a maximum of 2000 hp. for handling loads up to 400 tons. Power transmission from these engines to the various mechanisms they operate is controlled by the driller from his stand by means of air valves. (The power plant and control stand of one of these rigs were illustrated and described on Page 222 of our September, 1948, issue.) In addition to its numerous other uses on rigs of this kind, compressed air serves to start the diesel or gas engines. This is done either by introducing high-pressure air into the cylinders or by means of an air-powered starting mechanism that operates on much the same principle as the starter of an automobile.

[3]The mousehole is a section of 6- or 8-inch pipe set vertically in the ground in front of the rotary table and in line with the ramp or skidway leading to the pipe rack. A joint of pipe about to be added to the string is moved from the rack and stood in the mousehole to await further handling. Sometimes the kelly is "stabbed" (screwed) into it to make the transfer, at others the joint is picked up by the elevators and added to the string, which is then lowered before the kelly is affixed to the topmost member.

[4]Sand line originally referred to a wire rope used on cable-tool drilling rigs for lowering and hoisting the bailer when cuttings were removed from the hole. On rotary rigs it refers to any general utility line of ½-, 9/16-, or ⅝-inch section.



BUILT-IN AIR COMPRESSOR

Virtually all rotary drilling rigs now manufactured incorporate an air compressor, which is usually driven by power take-off from some convenient shaft. The unit shown, with its storage tank in the foreground, is an Ingersoll-Rand 5-hp., 2-stage, air-cooled machine. Today, as the convenience and savings through the use of air power become better known, there is a trend towards larger rig-mounted compressors. Meanwhile, on many operations, one or two separate portable units are often brought in to supplement the stationary machine.

One advantage of an air starter over an electrical device is that it does not present a fire hazard.

After a productive well has been drilled to an oil-bearing formation, the tubing through which the oil and gas will flow is ordinarily run from the surface to the bottom of the hole, the sections being joined by screwed couplings. The outside diameter of the pipe may be anywhere within the range of 2 to 3½ inches. In making up the string as it is progressively lowered, an air-operated tong is widely used. It is suspended at normal working height by a wire line and held out of the way when not in service. Swinging the tong against the tubing automatically locks its jaws around the pipe. Then the jaws and the length of pipe being added to the string are rotated by power from an air motor applied through a 2-speed gear mechanism to a split-ring gear to which the jaws are anchored. Air at a pressure of 80 to 90 psi. is used, and the tube section is screwed up until the motor stalls, thus assuring uniform tightness throughout the string. When the grip of the jaws is released by reversing the air motor, the tong can be swung free. To change from making up to "breaking out" or disjointing a string, the tong is merely turned over by means of a roll-over ring.

After a well has been producing for some years it may be necessary to withdraw the tubing, clean or renew the strainer on the bottom, clean out the well, and run the tubing back in. As the derrick used during the drilling period was removed when the well was completed, these "workover" jobs are accomplished with the aid of portable derricks or gin poles. An air-operated tong is almost always included in the equipment. A similar but smaller tong serves to make up or break out sucker rods which transmit power to bottom-hole pumps that raise the oil after the well has stopped flowing under either natural or injected gas pressure.

In marine drilling operations, conducted from submersible barges "landed" on marshy bottoms, the rig is built with two levels to conserve space. On the upper one are the drawworks, rotary table, pipe rack, and other hole-making equipment; the lower floor, or main deck of the barge, supports the mud pumps, rotary drive, control equipment, etc., for the well itself. This separation of machinery, which places pumps and their drives out of sight of the driller, introduced problems of control that were easily solved by the application of compressed air.

The pumps that handle the mud and deliver it to the bottom of the hole to cool the bit and to bring cuttings to the surface are placed as close as possible to the mud pits in the barge hull so as to reduce the suction lift. Three form the usual complement on a barge, and their operation is concentrated in as many short levers on the driller's control panel. A simple flick of the switch admits air to or releases it from the control unit on the throttle valve. This causes the particular pump to respond instantaneously, in contrast to the slow and tiring work of hand "wheeling" a valve, which is required of the man at the pump by the old method. By means of the levers, pumps may be set for any desired speed from barely turning over to maintain fluid level when drilling is halted to maximum flow when operating at top capacity.

Air under the diaphragm of the throttle control adjusts the position of the latter in accordance with the rate of steam flow, while its release permits the device to close and cut off steam. The throttle unit is inverted for ease of installation and better regulation, with the actuating air fed through a flexible metallic-hose connection to obviate the

BLOWING WATER WELL WITH AIR

When oil wells are drilled in areas where water is not readily available, a separate small-bore well is drilled to supply this essential fluid. The latter is commonly flowed by air-lift. Oftentimes, as in the case pictured here, a compressor is provided solely for this purpose. The machine shown is an Ingersoll-Rand Type 30 air-cooled unit of 80 cfm. capacity driven by a 4-cylinder, water-cooled gasoline engine. The complete unit, mounted on steel skids to facilitate moving it in the field, was fabricated by the Holders Equipment Company.

possibility of rig vibrations affecting the adjustment.

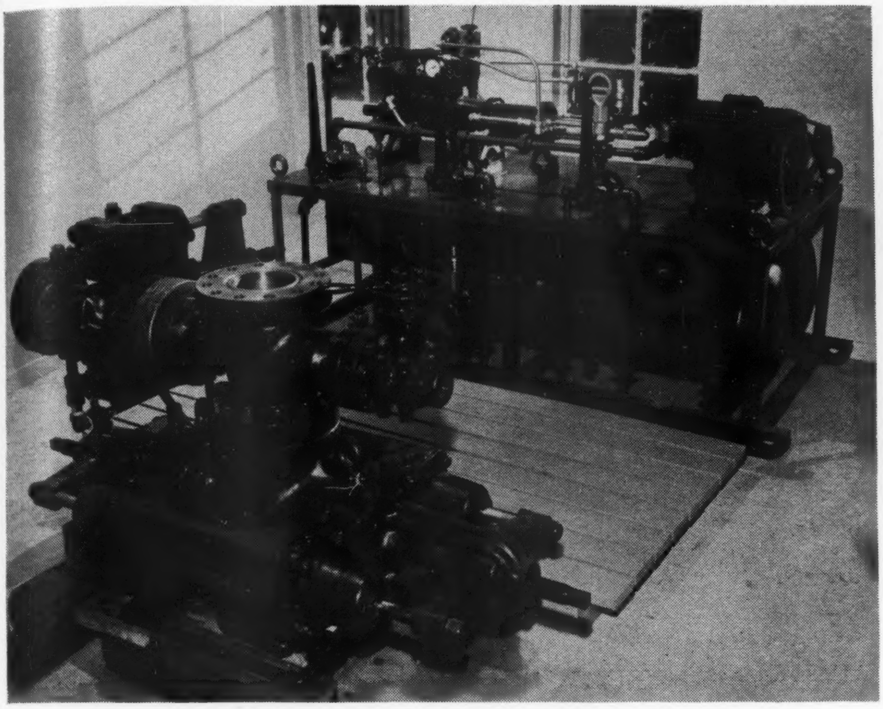
To prevent accidental injury to a crewman, or damage to a pump should the driller on the deck above operate it while the pumpman is working on the unit, each throttle is provided with a second air control. By means of a quarter-turn 3-way valve the air fed to the throttle from the driller's panel is cut off and a supplemental control located adjacent to the pump is put on the line. With the latter, the operator can run the pump slowly, can inch the piston, or put the unit into full operation, as may be desired, independent of any movement of the lever on the main panel. These separate controls also allow freeing any unit for the purpose of circulating mud in the pits or, in case of emergency, for pumping out the ballast tanks of the barge so that it can be floated from its bed in the marsh preparatory to towing it to a new drilling location.

Control of the steam engine that drives the hoisting unit on the largest marine rigs is also air-operated. The 14x14-inch twin-cylinder engine, mounted behind the drawworks and its transmission unit, is fed steam through a throttle valve with the same type of control as that of the pump drive. The short throttle lever on the switch panel insures any desired speed ahead or reverse from idling to the engine's maximum rate. Reversing is done by an air cylinder actuated by a push button, as on some steam locomotives. The stem of the steam valve, which is supported between the steam chest and the main riser, is equipped with a disk that travels past a tab attached to a yoke joining the throttle and air control. By this arrangement the valve position may be determined visually without dismantling.

Just ahead of the throttle in the steam line is an emergency cut-off valve, normally air-operated, that serves to close the line and stop the drawworks drive in case of accident or damage to the main throttle. This quick-acting valve is push-button controlled through a short piston that kicks out a retaining dog and allows a weighted handle to drop, swinging a blanking disk across the steam flow and effecting immediate closure. The knock-out lever extends through the valve housing so that the device may be manually tripped without the need of going to the panel if the emergency be serious. The cam on this valve is designed so that simply reopening the unit automatically latches the air trip into position for functioning.

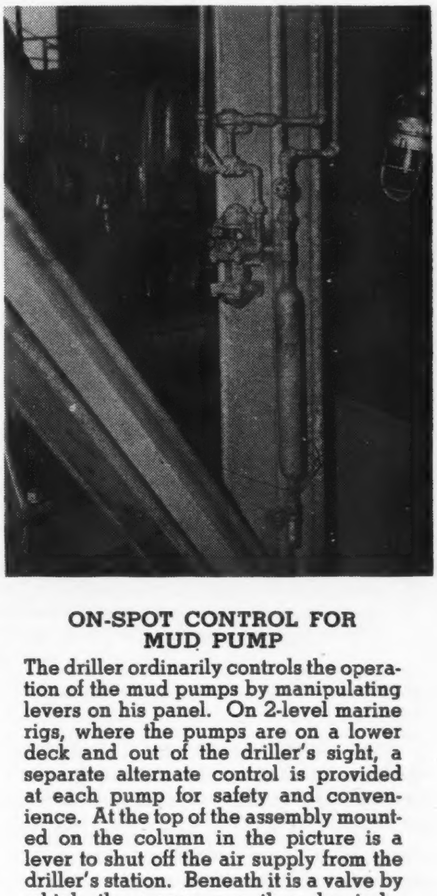
Because compressed air is required only intermittently on a drilling rig and no single service requires a large volume, it has been possible in the past for a small garage-type 2-stage compressor of from 3- to 10-hp. to meet its needs. In recent years, however, increasirg depth of wells has necessitated employing progressively larger and more powerful rigs. Capital investment has therefore risen enormously and, with labor charges also higher than ever before, drilling contractors and oil companies are vitally interested in saving as much time as possible in putting down a well. In consequence there is a tendency to use air controls and air-powered tools wherever they will accomplish that end.

The result is a trend towards larger compressors. Some rigs are now provided with a 15-hp., air-cooled unit such as the one pictured at the bottom of page 58. It has a piston displacement of 81.8



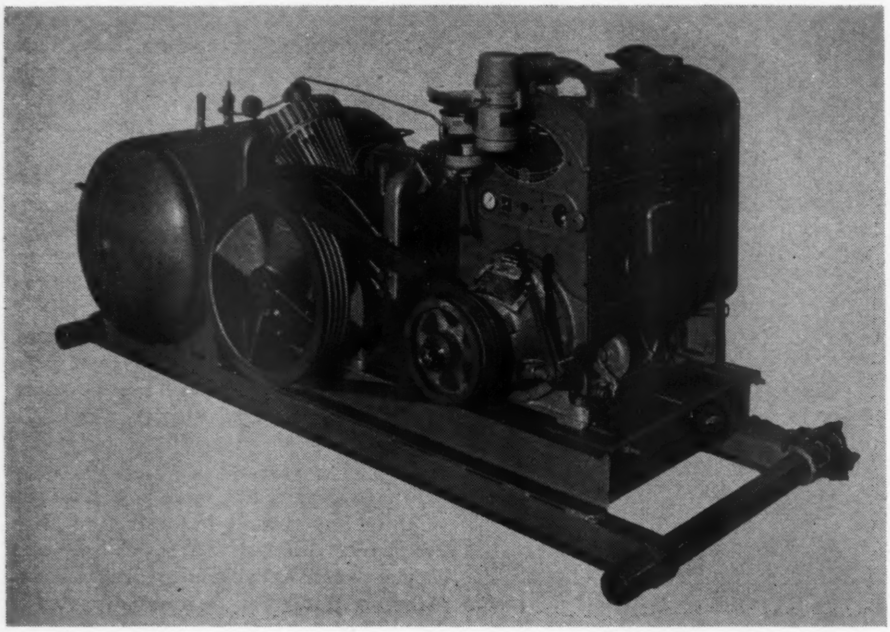
BLOW-OUT PREVENTER

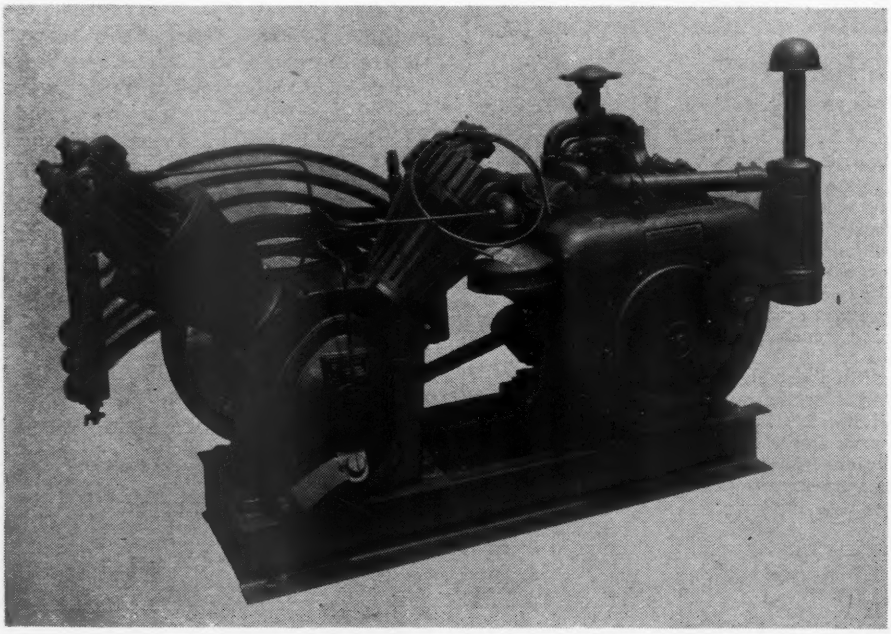
Early oil wells sometimes came in as uncontrolled gushers, flowed wild for days or weeks, and wasted valuable oil and gas. Occasionally they caught fire and entailed costly, prolonged, and dangerous efforts to extinguish them. This led to the development of multiple valves for closing in the flow. These were supplemented by a device known as a blow-out preventer, which is designed so that drilling can continue against the well pressure until the bit has penetrated the producing formation as far as desired. The preventer is secured to the outer well casing and has rams that can be moved inward to fit closely around the drill pipe. These were originally hand-operated. Then hydraulic pressure was applied by pumps actuated by steam on boiler-equipped rigs and by compressed air on others. A recent development is the McFarland blow-out preventer which uses compressed air, steam, or water pressure for operating its high-volume, high-pressure pump. The manufacturer recommends air power as the most efficient medium; and, to apply it readily, the Holders Company makes up a unitized assembly consisting of an Ingersoll-Rand motor-driven air compressor and a McFarland pump mounted on a common steel base. To put it in operating condition, it is necessary only to run electrical wires from a switch box to the compressor and to connect the high-pressure hydraulic lines from the pump to the preventer. The picture shows one of these units set up for testing the Cameron blow-out preventer in the foreground.



ON-SPOT CONTROL FOR MUD PUMP

The driller ordinarily controls the operation of the mud pumps by manipulating levers on his panel. On 2-level marine rigs, where the pumps are on a lower deck and out of the driller's sight, a separate alternate control is provided at each pump for safety and convenience. At the top of the assembly mounted on the column in the picture is a lever to shut off the air supply from the driller's station. Beneath it is a valve by which the pump can then be independently controlled. The elongated chamber below and at the right of the valve collects moisture that condenses in the air line and prevents it from reaching the valve.





HOLDERS EQUIPMENT COMPANY PHOTOS

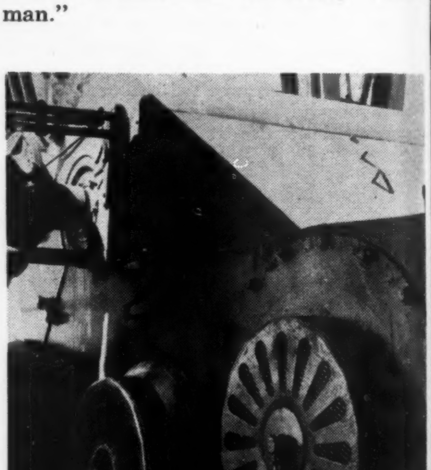
UTILITY COMPRESSORS

Skid-mounted air compressors of various types and sizes, with gasoline-engine drivers, are made up to furnish supplemental air on rigs having built-in compressors or to give complete service to rigs that are without air power. The unit in the lower picture furnishes air at 500 psi. pressure for starting the main internal-combustion engines of a large rig. It is also used to test pipe lines. A general utility machine is shown at the top. In addition to serving drilling requirements, a compressor of this type is often employed to pipe oil out of a field while storage tanks are being built. In such cases it provides air to operate impact wrenches and other pneumatic tools during the construction period, as well as for spray-painting the tanks after they are completed. The compressors are Ingersoll-Rand air-cooled machines.

cfm. at a discharge pressure of 100 psi. and can be utilized for pressures up to 250 psi. At present, a machine of this size has some reserve capacity that will permit the use of additional time- and labor-saving pneumatic equipment as it becomes available. Because the replacement of muscles with air power makes for economy, rig builders and oil-field engineers and operating men are studying potential pneumatic applications all the while. In view of these trends, it is likely that compressors in the 25- to 30-hp. range will be common on large rigs within a few years.

An air compressor is usually standard equipment on newer rigs and is commonly belt- or chain-driven from some convenient part of the power-transmission hook-up. Where a standby is not included by the rig manufacturer, air for start-up and to carry on operations until the rig unit has taken over is generally furnished by a gasoline engine-driven machine and tank of the service-station type. Except when making round trips (a string of pipe going into and coming out of the hole), the compressor is in use only a small part of the time. Even when laying down pipe, the period between stacking one joint and getting the next broken out of the string is more than sufficient to build up a full storage of air.

Although it is frequently necessary to slow down operations or wait for some of the equipment to "catch up" with the job, compressed air is always ready to lighten or take over completely the heavy work of the crew. It's the "roughneck" who never tires, never tips a bottle too often or too far, and never harbors a grudge against driller or management. Today's deep wells would be far harder to drill, would require larger gangs, and would cost far more than they now do with compressed air—the crew's unseen but ever-ready "extra man."



AIR CLUTCHES

These two clutches mounted on the main and jack shafts of a heavy-duty drawworks make for instant, smooth, and flexible operation. Screened openings protect contacting surfaces from damage. Filters interposed in the air lines just above the floor remove dust and moisture.

Canada's Tenth Province

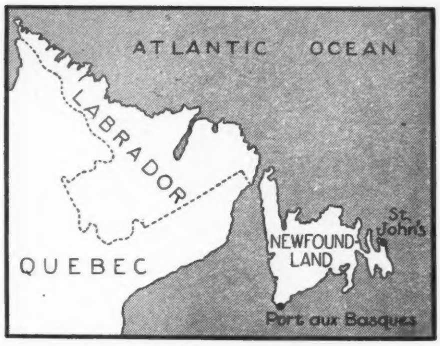
E. L. Chicanot

NEWFOUNDLAND, including Labrador, is shortly to become the tenth province of Canada—a matter of great interest, importance, and significance not alone to the Dominion but to her neighbor, the United States. This addition of 162,750 square miles and 327,750 people to the country removes what has long been regarded as something of an anomaly—a section of the mainland, and an island in the Gulf of St. Lawrence separated from it by a mere 12 miles, lying entirely outside the sphere of Canadian sovereignty. It rounds out the Dominion and achieves the dream of the Fathers of Confederation of a great British state stretching from the Atlantic to the Pacific. Henceforth all that part of the British Commonwealth north of the international boundary will speak with one voice, will have its major policy-making centered in Ottawa.

It is the sixth and final stage in the development of a modern self-governing nation. When federation took place in 1867 it united the divisions of British North America that are now known as Ontario and Quebec (Upper and Lower Canada), New Brunswick, and Nova Scotia. In 1870 Manitoba became the fifth province; British Columbia and Prince Edward Island decided to join the union in 1871 and 1873, respectively; and in 1905 the provinces of Alberta and Saskatchewan were carved out of the western prairie. That brought the number to nine provinces, which have constituted the Canadian Dominion ever since. There remain the Northwest Territories and the Yukon Territory which are still administered by commissions from Ottawa. They have been a part of Canada from the earliest times and may some day become a province or provinces.

It has always seemed logical that Newfoundland should be a constituent part of the great North American Dominion, and delegates from the island attended the first meetings convened in 1867 to consider union. Newfoundland, however, rejected the invitation, though the way was left open for her reception. The matter again became an issue in 1895, but once more the decision was "No." Only today, after experiencing many viscissitudes in the intervening period, has a majority of the islanders expressed a desire to join Canada. Arrangements to this end are at present being made between Britain, Canada, and Newfoundland, and formal entry of the Province of Newfoundland into the Dominion is scheduled to take place on March 31.

Though coming about voluntarily, it is a momentous and affecting step, this smaller nation casting in its lot with the larger one. Newfoundland is Britain's oldest dominion, second in age only to Virginia among the North American colonies. Settled in the first place by sturdy French and British stock, existence on the island with its rugged terrain and rigorous climate has, through the generations, developed a hardy and self-reliant people, one that has loved its independence and is passionately attached to its land. Only force of circumstances has induced the Newfoundlanders, nearly 82 years after the invitation was first extended, to cast in their lot with what is, after all, another country, no matter how friendly has been the association, how fraternal the relationship, in the past.



THE NEW PROVINCE

Newfoundland has an area of 42,000 square miles—slightly less than that of New York State. Labrador is almost three times larger. The total population is 327,000, of which Labrador has only 5500. Newfoundland has little claim to self-sufficiency and is strictly an export-import country. The island's economy is based largely on fishing and lumbering. Its highway system is confined generally to regions around coastal settlements, with a few roads leading to interior lumbering sections. The only cross-island travelway is a circuitous, 547-mile, narrow-gauge railroad between St. John's and Port aux Basques. When Newfoundland joins Canada at the end of this month, it will be the first province to be added to the Dominion since 1905 when Saskatchewan and Alberta were brought into the union.

Newfoundland was discovered by John Cabot on June 24, 1497, the landing point being hailed as Prima Vista, the present Cape Bonavista. It was visited by the Portuguese navigator Gasper de Cortereal in 1500, and within two years regular fisheries had been established on its shores by Portuguese, Biscayans, and French. Sir Humphrey Gilbert arrived in St. John's Harbor in August, 1583, and formally took possession of the island in the name of Queen Elizabeth. Its history during the seventeenth and part of the eighteenth centuries is little more than a record of rivalries and feuds between the English and French fishermen; but by the Treaty of Utrecht, the island was ceded wholly to England in 1713. A governor was first appointed in 1728, and in 1832 representative government was established. In 1855 it attained self-governing status, the first British colony to do so.

That, in brief, was the state of affairs until the early 1930's when, in the accentuating depression, world markets on which Newfoundland depended collapsed and economic conditions fell to such an extent that one quarter of the people were on relief. Financial difficulties reached a state that compelled recourse to the motherland for assistance. A Royal Commission of His Majesty's Government visited the island and recommended that, in consideration of certain monetary aid, responsible gov-

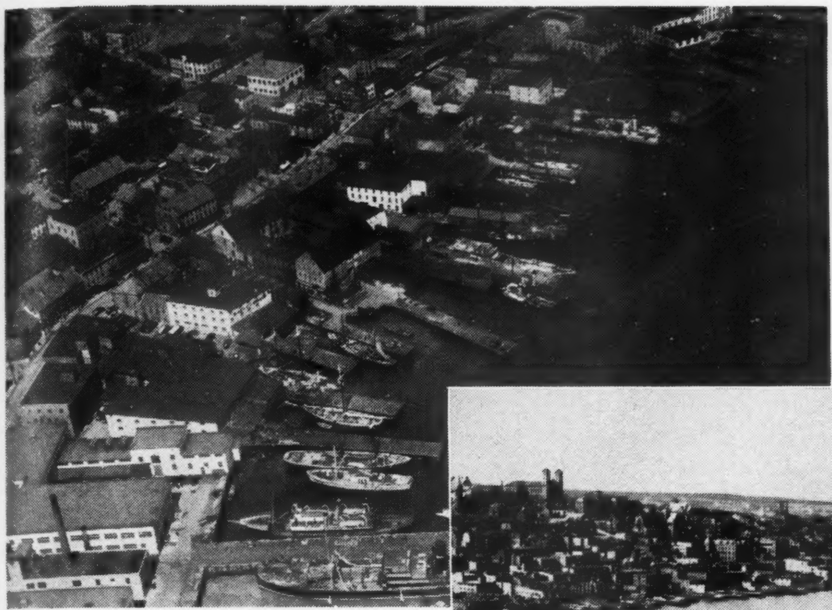
MARSHALL STUDIOS PHOTO

STEAMER ENTERING TRINITY HARBOR ON THE EAST COAST

RUGGLES STUDIO PHOTO

FISH STAGES AT POUCH COVE

This picture, taken near St. John's, dramatically illustrates the rugged and difficult job of the Newfoundland cod fishermen. When the boats come in with their catches, the fish have to be "pronged" up two or three platforms to the "splitting stage," and then moved higher up the cliff where the flakes are spread out to dry. In places they hang like lichens on the barren rocks. The platforms are built of twigs and boughs and are sometimes swept away by heavy seas. Not all the harbors are as rocky and unprotected as this one, however.



RUGGLES STUDIO PHOTO

ST. JOHN'S

Much of Newfoundland's commerce is channeled through this its largest city. Until the end of 1947 traffic on the island moved on the left side of streets and highways. Now St. John's bus riders have to enter and leave on the side away from the curb, and this will continue until new vehicles are provided. Street-car and bus fares are still five cents, but food and clothing cost more than in the United States. The view below pictures the city from Southside. The other shows a section of its extensive waterfront.

ernment should be suspended and administration vested in a governor acting on the advice of a 6-member commission until the island again become self-supporting.

The war years brought totally unforeseen importance to Newfoundland by reason of the fact that it is the section on the North American Continent nearest to Europe. In January, 1941, several sites were leased to the United States for air bases. American forces in large numbers carried on operations there and spent money in a hundred directions. It became the jumping-off place for bombers manufactured in eastern Canada for delivery overseas. The bankrupt little island ended the conflict with a surplus of $29,000,000. With postwar development of civil transatlantic flying, it maintained its place in world aviation, and the great international airport at Gander continued to be active and to bring prosperity.

Outside rule irked Newfoundlanders, but the question of the island's future form of government again came up for deliberation after the cessation of hostilities. The matter of federation with Canada was resurrected, and in 1947 a delegation visited Ottawa to negotiate terms. In October of that year the Prime Minister sent to the Governor of Newfoundland a statement that made known "the terms believed by the Canadian government to constitute a fair and equitable basis for union between Newfoundland and Canada." In June, 1948, the people were given the first opportunity to voice their preference. There were three choices, and the continuance of commission government lost heavily. A second referendum was held in July and offered the alternative of responsible government or union with the Dominion. The majority voted for the latter.

Which country is expected to gain from the union? Newfoundlanders clearly envision some advantages in surrendering independence, for they would not have decided in favor of it. Canada obviously does not expect to lose greatly, for she would not have signified her willingness to negotiate nor offered the generous terms she did. The truth is that the potential benefits seem to be mutual. The bulk of the islanders should begin to profit almost immediately, the existing Dominion of Canada ultimately.

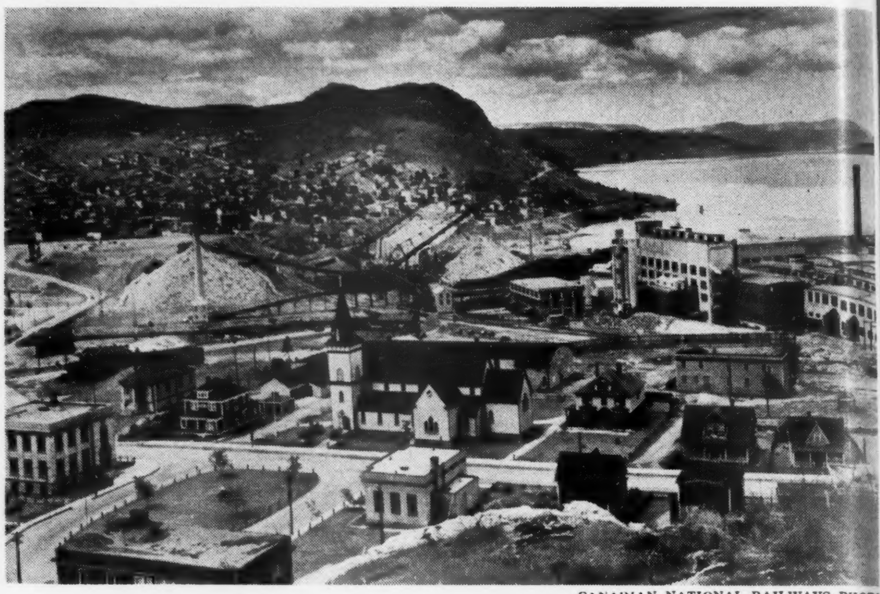
To understand this, one must try and get a picture of Newfoundland which, though so close a neighbor of the United States, has yet to be discovered by most of the latter's inhabitants. As one approaches the island from the sea it presents a wild and sterile appearance. The surface, however, is diversified, ranging from mountains to marshes, barrens, ponds, and lakes. The number of the latter is remarkable, well over one-quarter of the whole area being covered with fresh water. On more than half are stands of timber of commercial size. The coastline everywhere is deeply indented with bays and estuaries affording safe harbors. Scenically it is magnificent in its rugged grandeur and comparable in many respects to that of Norway.

It cannot be denied that life has been hard and rigorous for most Newfoundlanders. Fishing is the main activity, the waters abounding in cod, and a large percentage of the people is engaged in some way with the finny harvest. Forestry pursuits and the manufacture of newsprint constitute the island's second industry. Several minerals are produced commercially; but agriculture is of little importance. Most foodstuffs have to be imported in exchange for fish, iron, lead, zinc, newsprint, and pit props.

Confederation will reshuffle the economy. Tariffs will be abolished, and instead of getting 50 percent of her revenue from this source, as she has been in the habit of doing, Newfoundland will have to obtain it by direct taxation. For such staples as food and clothing the inhabitants will pay less, though items in the luxury class may be dearer. It has been estimated that the ordinary cost of living may be reduced as much as 25 percent.

But more important still is the fact that union with Canada will open to the people the benefits of the Dominion's established and expanding social-security program. On the day Newfoundland becomes Canada's tenth province, the islanders will be eligible for family allowances, old-age pensions, unemployment insurance, sick-mariners benefits, and assistance for housing under the National Housing Act. They will likewise profit from the Dominion's health-insurance program, which is commencing to unfold. Social benefits envisioned probably had more to do with inducing the people to vote for confederation than any other factor.

As an integral part of the Dominion, Newfoundland can expect to experience an intensified development of her natural resources. Those in Labrador, for instance, are known to be great and untapped (an article on this subject appeared in our February, 1949, issue). Canada will take over the island's narrow-gauge and somewhat antiquated railroad, which will become a part of the government-owned Canadian National Railways. She will also acquire the coastal boats, hotel, postal and telegraph services, civil aviation including the Gander airfield, customs and excise, veterans' pensions, fisheries, marine hospitals, and lighthouses. It has long been the Dominion's policy that no foreign power shall possess military bases on her territory. Accordingly, she will ask for a modification of the terms under which the United States, by arrangement with the United Kingdom, holds 99-year leases on bases in Newfoundland. The plan is to establish two naval-reserve divisions on the island.



CANADIAN NATIONAL RAILWAYS PHOTO

CORNER BROOK

This west-coast town on the Humber River and 140 miles north of Port aux Basques is a salmon-canning center.

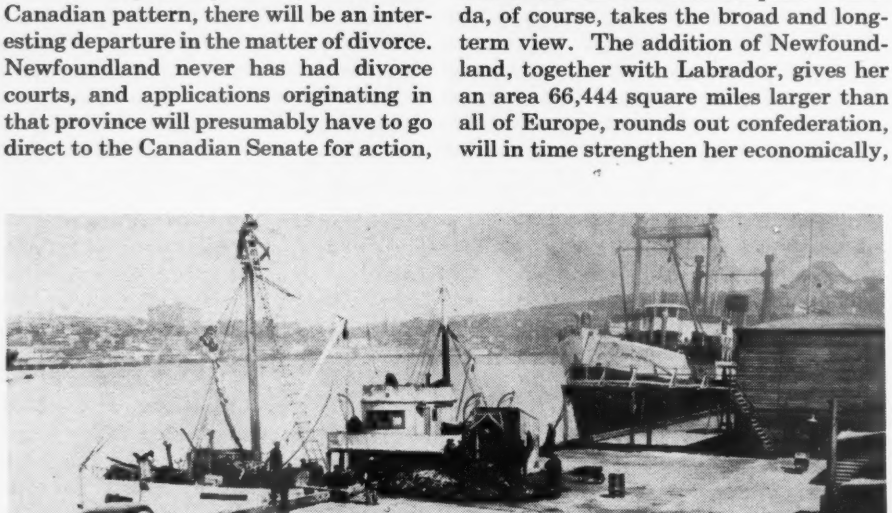
The new relationship will involve the election of a provincial government in Newfoundland and the sending of representatives to the House of Commons and the Senate at Ottawa. Seven members will go to the lower and six to the upper house. Immigration bars will be removed, permitting the islanders to move without restriction to any other part of the country. While the judicial system to be set up will probably follow the Canadian pattern, there will be an interesting departure in the matter of divorce. Newfoundland never has had divorce courts, and applications originating in that province will presumably have to go direct to the Canadian Senate for action, as is now the case with those made in Quebec.

The entry of Newfoundland into the union will be an expensive thing for the Dominion in the first place, and probably for a long time to come. The former will receive in the way of benefits much more than she will pay in taxes. Ottawa will shoulder the national debt and leave the island with its war-born surplus. Canada, of course, takes the broad and long-term view. The addition of Newfoundland, together with Labrador, gives her an area 66,444 square miles larger than all of Europe, rounds out confederation, will in time strengthen her economically, and make her more readily defensible.

As a democratic country becoming part of a larger democratic entity, Newfoundlanders, so far as their general living conditions go, will scarcely be aware of any change. A profoundly Christian people, among whom Roman Catholics apparently lead slightly over the Church of England, followed closely by members of the United Church, their religious practices will in no wise be disturbed. Education being a provincial matter, the island will continue its unusual procedure by which the government supports a separate school system for each major denomination. The placid though somewhat stern existence of most of its inhabitants will be unaffected, but their economic conditions are expected to improve.

It is only sentimentally that many may feel a heart tug in the knowledge that their self-sufficiency and independence, which have been their heritage from the day of settlement until fifteen years ago, have come to an end—that now they will be known as Canadians first, Newfoundlanders second. But it is the choice of the people, and it is to be hoped that that feeling will be buried in pride in being residents of a province of Canada. As Prime Minister King has said:

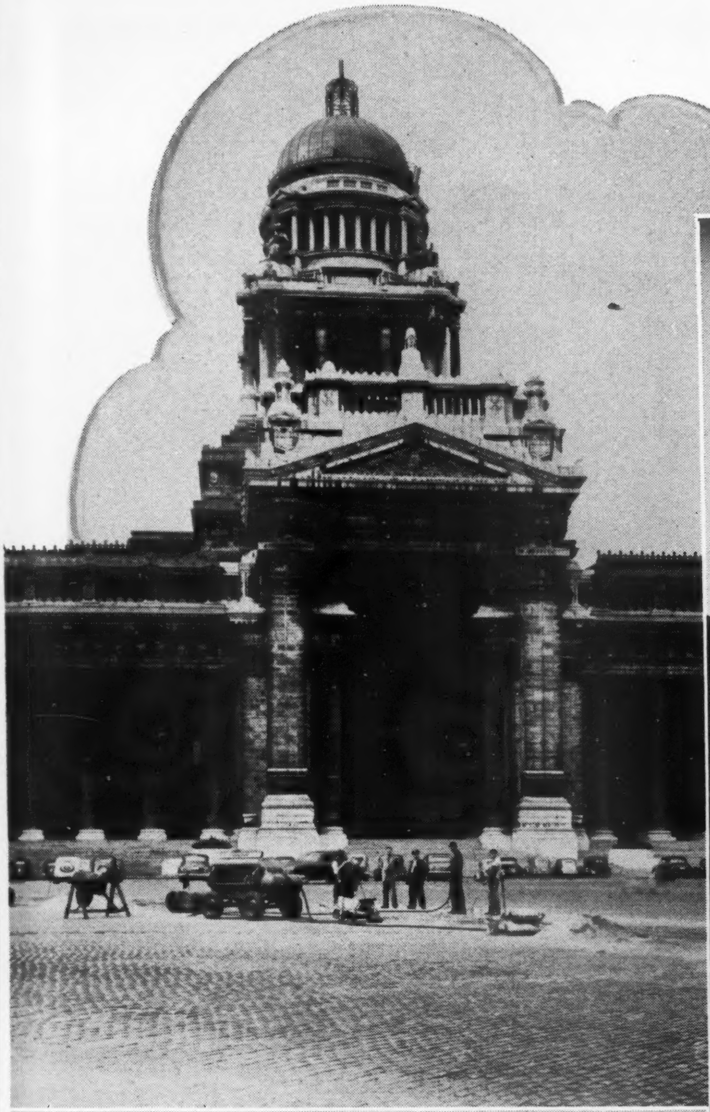
"The union, when effected, will seal into constitutional terms a close and fraternal association which has existed, in war and peace, over many years . . . . The union of Newfoundland and Canada, two North American democracies in the British Commonwealth of Nations, will add strength to both. Together, as partners, we may look forward to the future with more confidence than if we had remained separate political communities."

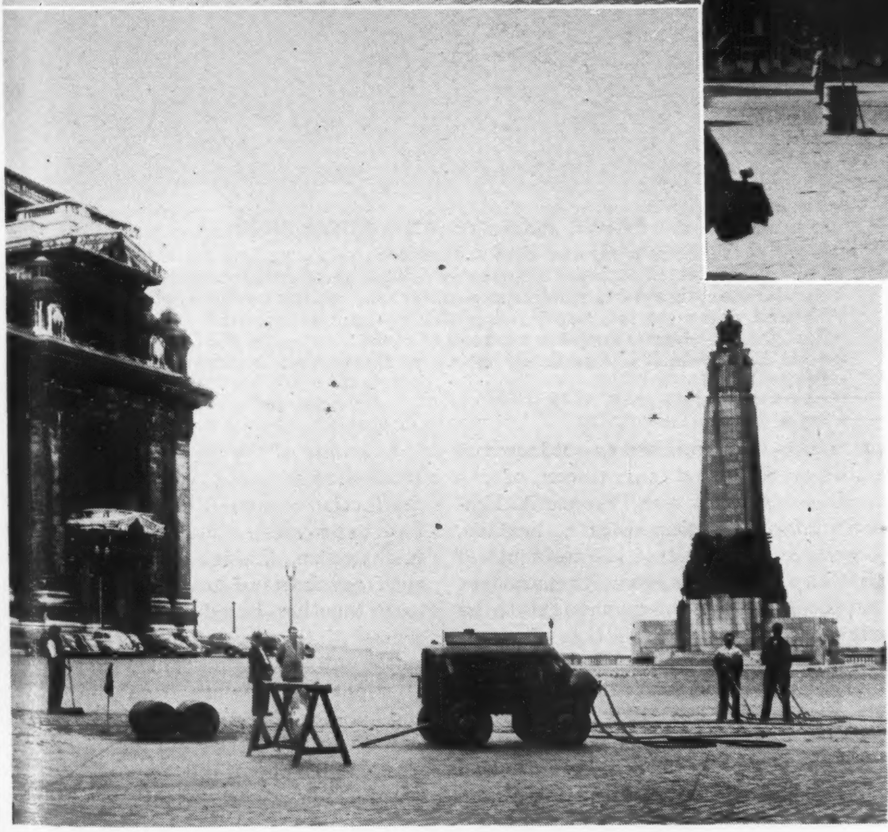


CANADIAN NATIONAL RAILWAYS PHOTO

SEAL CARCASSES ON A SOUTHSIDE PIER

Air Power in Brussels



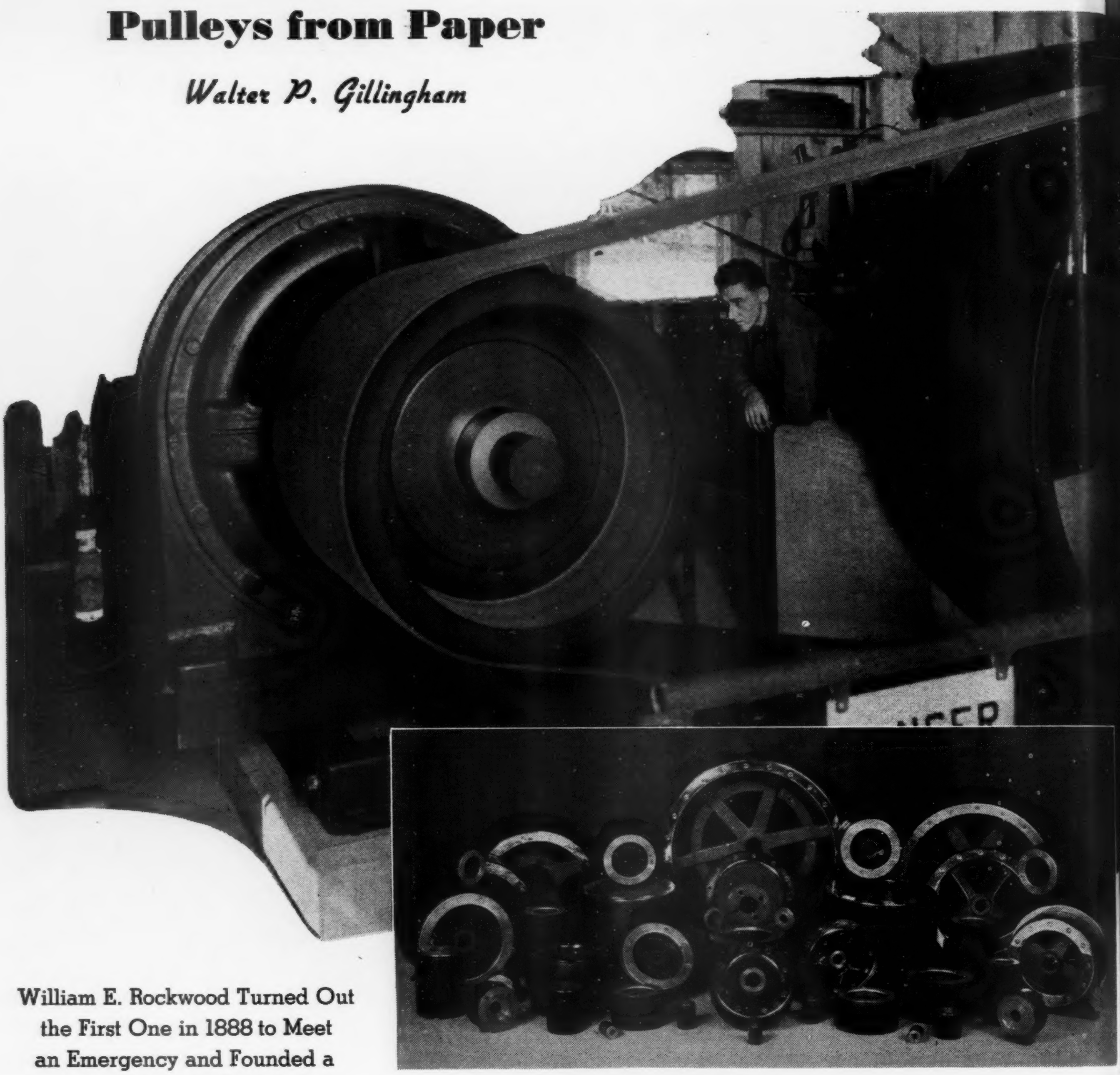


OLD-WORLD STRUCTURES

Air compressors and air-operated tools are usually pictured in construction or industrial settings. Actually, however, they work in many environments and may often be found in aesthetic surroundings. In the accompanying views, some of the famous architectural landmarks in Brussels, Belgium, serve as backgrounds for Mobilair streamlined portable air compressors. The structure above is the Hotel de Ville, or city hall. Built more than four centuries ago, it is considered one of Europe's most beautiful edifices. At the upper left is the Law-Courts Building. The third picture shows the monument erected in memory of the 1914-18 infantry and one end of the Law-Courts Building.

Pulleys from Paper

Walter P. Gillingham



William E. Rockwood Turned Out the First One in 1888 to Meet an Emergency and Founded a Business That Still Thrives

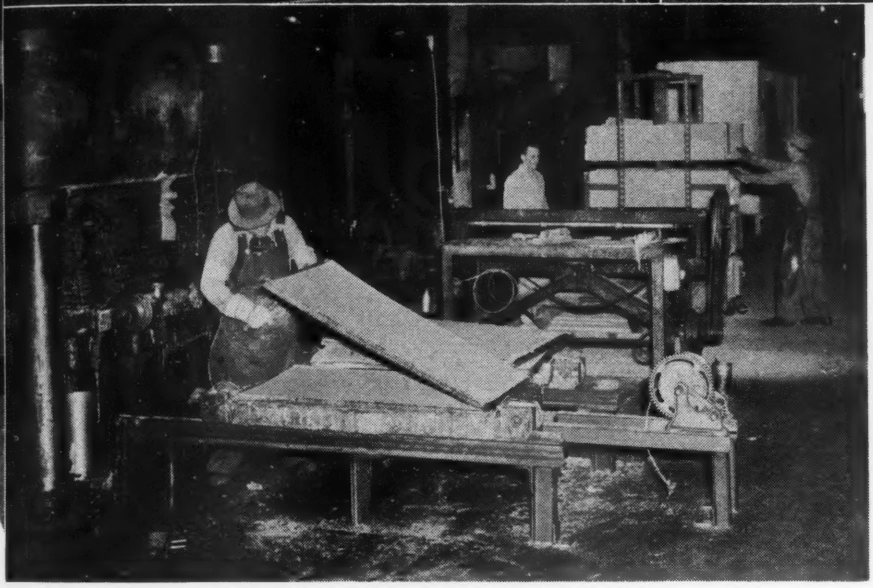
PAPER PULLEYS AND THEIR USES

A few of the many types and sizes of Rockwood paper pulleys are shown above. Units up to 6 feet in diameter are used for driving generators, compressors, pumps, circular saws, threshers, grinders, separators, and many other kinds of machinery. Pictured at the top is a paper pulley driving an Ingersoll-Rand air compressor. The 200-hp. motor is mounted on another of the company's products—the Rockwood base—which automatically maintains the correct tension on the leather driving belt.

PAPER may seem to be a fragile substance from which to fashion machinery parts, yet, if properly treated, it is suitable for the purpose. An outstanding example of this kind is the paper pulley. For more than 60 years Rockwood Manufacturing Company, Inc., has been making and selling such pulleys for driving all types of machinery. The history of the firm, the pioneer in this field, is as interesting as the procedure by which the pulleys are manufactured.

If a certain foundry had made it a practice to cast iron pulleys more than once a week, the paper pulley might never have come into being. The year was 1888, and the place Indianapolis, Ind. Alert and progressive promoters of a new theater being opened there had gone East and secured for their show an attraction that promised to outdraw and outshine the most curvaceous of the feminine cast. It was Thomas A. Edison's latest invention—electric lighting, a wonder that most of the residents of that city had never seen. Preparations for the gala night were thought to be complete with the installation of a generator, an oil engine, incandescent bulbs, and wiring. However, three days before the opening date the pulley on the engine broke. Another one could not be obtained in time, and the local foundry was not scheduled to make castings again for several days.

Learning of the situation, William E. Rockwood, a young man engaged in the production of sawmill equipment, undertook to provide a pulley so that the show might go on. Taking a number of disks cut from sheets of heavy paper he glued them together, bored a hole through the center of the stack, and pressed in a metal hub. Then he drilled more holes at equidistant points from the center and inserted lengths of broomsticks so as to prevent the disks from rotating separately. This makeshift, he hoped, would last until a cast-iron pulley could be secured.



MAKING PAPER RINGS

Paper pulleys are built up of paperboard rings. To start with, large sheets of paperboard are glued together, one on top of the other, to make the desired ring thickness. Stacks of these assemblies, or books, which are kept separate by placing two unglued surfaces together, are put in a hydraulic press (left side, picture directly above) and compacted under great pressure. Next, the books are cut into strips, as shown, and dried in an oven. Then all except those for the largest pulleys go through automatic stamping machines (upper left picture) on which several groups of concentric rings, complete with dowel holes, are punched from each strip at one time. Taken to the build-up department, the rings, together with the wooden dowels, metal hubs, and more glue, are made into pulleys of various sizes. At the upper right are two of the many hydraulic presses used for this purpose. The one at the left is ready to drive the dowels into half the rings that make up a pulley. In the right-hand press, the metal hub has been set in place and the remaining rings have been added. Pressure in excess of 1000 psi. is then applied to force the assembly together.

The result was the forerunner of the modern paper pulley. Pressed into emergency duty in the theater's power plant, the substitute performed so well that it was never replaced. The leather belt that drove the generator gripped the paper pulley much tighter than it had the metal one, thus reducing slippage and causing the generator to supply more current for the lamps which, consequently, burned brighter than before. According to reports, Edison himself journeyed to Indianapolis to find out why his 16-candlepower lamps gave more light there than elsewhere, and was amazed to discover that the difference was attributable solely to a paper pulley.

In the meantime another theater in the city, unable to compete with its brilliantly illuminated rival, likewise installed electric lighting. Later the two houses combined and began to make and distribute electric energy, eventually becoming the Indianapolis Power & Light Company. Other public utilities were springing up throughout the nation at the time, and demands for pulleys started to pour in on the small establishment of William Rockwood. The business grew overnight, and in 1902 it was incorporated under its present name. The firm has continued to expand, and today it is the largest manufacturer of paper pulleys in the country.

There are several reasons why paper pulleys are used in preference to metal or wooden ones for many applications. The end grain of the paper is exposed to the surface of the leather belt, offering literally millions of tiny teeth that interlock with the fibers. This action greatly reduces belt slippage and, as already mentioned, permits the transmission and utilization of a larger percentage of the available power. What is more, the gripping surface of the pulley continually renews itself through wear. Another feature, and one that makes the paper type especially valuable in the generation of electricity, is that it is a nonconductor. Finally, it will take more abuse and hard knocks before breaking than other kinds.

At the Rockwood plant some 400-odd employees are kept busy turning out paper pulleys and a number of other products. In addition to the regular manufacturing equipment, it has a fully equipped foundry and an up-to-date machine shop. The management, with an eye towards higher output per man-hour, has mechanized wherever possible. To do this it was necessary to modify standard equipment because machines for the production of paper pulleys were nonexistent. One big multiple drill in use is homemade well-nigh throughout.

Paper comes to the Rockwood plant from nearby mills, much of the supply being obtained from Vincennes, Ind. The stock arrives in the form of paperboard sheets approximately $^1/_{16}$ inch thick. Three grades are used: straw,

tarred, and rawhide. The first-named is produced by reducing straw to pulp and then compressing it in machines to the proper thickness. Most of the pulleys are made of this material. Tarred and rawhide paperboard, which is impregnated with special compounds to impart toughness, durability, and resistance to wear, enter into the manufacture of friction drives and pulleys for special services.

As the first step in the transformation of paper into pulleys, the sheets are covered with a special silica glue which, upon drying, becomes hard, dense, and rock-like. The glue is delivered in liquid form by tank trucks and stored in underground tanks. From there it is pumped, as needed, to a gluing machine, coating the metal rollers between which the paperboard is fed in individual sheets except at regular intervals, when two are sent through the rollers simultaneously. This divides the paperboard into sections called "books." After a stack of these sections has been built up, it is put in a hydraulic press and subjected to a pressure of 1000-1200 psi., for from 10-15 minutes, thus welding the glued sheets firmly together and reducing the height of the pile from 32 to 25 inches. It is then removed from the press and split into its component books.

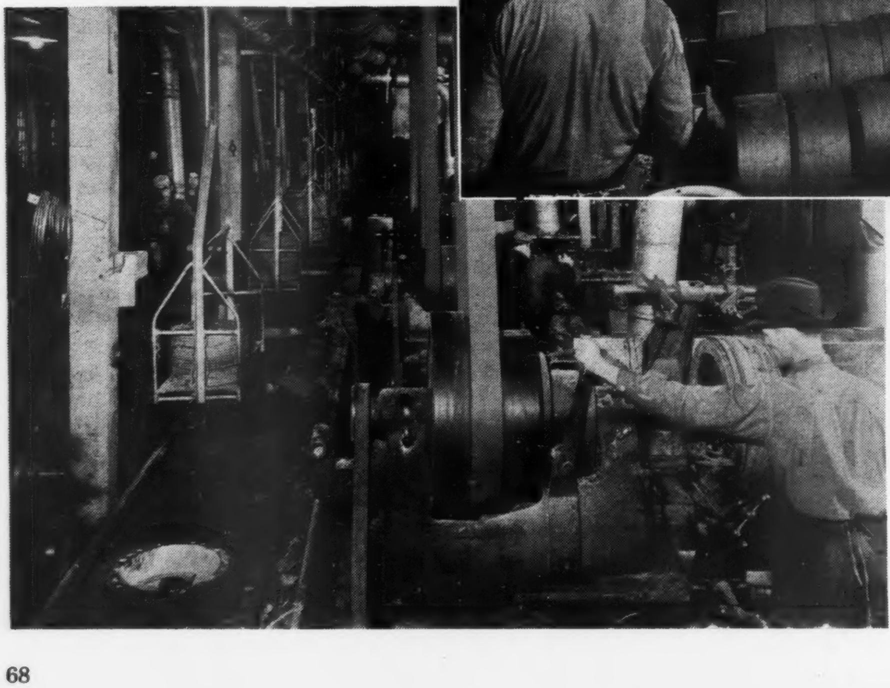
Each book is passed through a machine which cuts it into strips corresponding in width to the diameter of the pulleys to be made. The strips, placed on portable racks, are pushed into a drying oven where they are kept at a temperature of around 135°F. for a period of approximately six hours to remove excess moisture. This treatment changes the paperboard from a soft to a hard, dense, laminated material that is ready to be converted into rings that are the basis of the pulleys.

The biggest rings are turned from squares of prepared paperboard by fastening each flat to the side of a vertical wheel. As it is rotated, a sharp instrument held against the surface of the square cuts it into the desired shape. From there the ring goes to a post drill which punches the holes necessary for the insertion of wooden dowels and the crossarms projecting from the metal hub that fits the shaft of the machine with which the pulley is to be used. All other rings are stamped complete with holes by a battery of large-size automatic machines and a number of smaller units. To make use of as much of the raw material as possible, several groups of concentric rings are stamped from each strip of glued paperboard. Punched rings and scrap go from the machines to a conveyor belt from which the rings are picked according to size and tossed into bins. The scrap travels to the end of the belt, where it is collected, baled, and sent back to the mill for reprocessing into paperboard.

Rockwood pulleys range in diameter from 1½ inches to 6 feet and in width from 1½ inches to 4 feet. All are built by first assembling enough rings of the right diameter to the required thickness. Each must have a metal hub to fit the machine shaft, and these are cast of iron in the company's foundry where mass-production methods are practiced. A large stock of wooden patterns corresponding to the castings produced is kept in a storeroom, and those needed are sent to the foundry. There molds are quickly made from the patterns with the aid of various air-operated machines that perform such tasks as jolting and squeezing flasks to pack the foundry sand tight around the patterns, withdrawing the latter from the sand, or inverting molds that are too large to be turned over by hand.

After molten metal has been poured into the molds and been allowed to cool sufficiently so as to eliminate strains, the castings are shaken out and put through Roto-Blast machines where air-powered jets of sand remove any extraneous material clinging to them. Fins, gates, and the like resulting from the casting process are ground off by electric grinding wheels. Large castings are cleaned in a similar manner in a sandblasting machine, and unwanted projections are then removed by chipping and grinding with air-operated hand tools. Both the grinding wheels and the sandblasting equipment are fitted with dust collectors.

From the foundry the work passes to



TURNING AND BALANCING PULLEYS

Emerging from the build-up department, the pulleys, thoroughly dried, are placed on lathes that turn them to size, put crowns on the bearing surfaces, and trim the ends, all at the same time. In the view at the left, pulleys are seen arriving at the turning machines on overhead conveyors while others, that have been turned, dipped in oil, balanced, and fitted with end plates, are moving by belt conveyor to the painting department. Above, workmen are testing pulleys for balance. The chalk marks indicate where small lead counterweights are to be inserted to make the pulleys run in perfect balance.

FOUNDRY OPERATIONS

Hubs for pulleys are cast of iron in the company foundry. The worker pictured below is making a mold on a pneumatically operated jolt-squeeze-strip machine. In some of the uncovered molds on the floor are dry-sand cores that form the central opening in the metal hub that fits the shaft of the machine with which the pulley is to be used. The castings shown at the right are being rough ground before going to the machine shop where they will be bored, reamed, milled, and finished.

the machine shop. There the hubs are broached, keyways cut, and holes drilled for setscrews. All bores of finished castings are checked with plug gauges and are held to an oversize tolerance of 0.002 inch. The hubs are now ready to go to the assembly room.

The wooden dowels used in the construction of the paper pulleys are made of hardwood—mostly oak and maple—in a different section of the plant. The material comes in long, square strips which are passed through a machine with a rotating cutter blade. From there they emerge in the form of rods which are cut into the required lengths.

Paper rings, metal castings, and wooden dowels for many different sizes and types of pulleys meet in the assembly room where the procedure followed in each case is substantially the same. Pulleys larger than 5½-6½ inches in diameter are put together by the hydraulic method. Some are made by building up rings to the desired thickness, holding them together with glue and dowels, and forcing a metal sleeve into the center opening by hydraulic pressure. In pulleys with spoke- or web-type hubs the casting is an integral part. In the latter case, half of the rings needed is dipped in glue and then assembled on upright iron rods to line up the holes for the dowels, which are forced in by a hydraulic press. Next the casting is put in position with the crossarms which project at right angles from the ends of the hub spokes fitting into their respective holes. When the remaining similarly treated rings have been added, the whole assembly is subjected to more than 1000 psi. pressure and set aside to dry.

The pulleys are now ready for the finishing touches. First they are turned to the correct size and contour on machine lathes. If intended for outdoor service, they are made weatherproof by dipping them in a bath of road oil. Those too large for dipping are treated by bringing their rims in contact with oiled rollers.

Pulleys are next tested for balance. This vital factor is determined in two ways—by the static or dynamic method. In the case of the former, a pulley in horizontal position is supported at its center of gravity; in the latter, it is mounted on a revolving shaft. Those up to 14 inches in diameter are checked for static balance, unless the customer requests the dynamic test, which is applied to all larger than 14 inches. If counterweights are required to correct out-of-balance, small lead weights are inserted into shallow holes bored in the ends of the pulleys. That done, metal end plates, stamped out in the machine shop, are attached by automatic nailing machines. The pulleys are then spray painted and put on a conveyor which travels in a slow, continuous movement around the assembly room. By the time they have returned to their starting point they are dry, ready to receive a coat of lacquer to protect their finish.

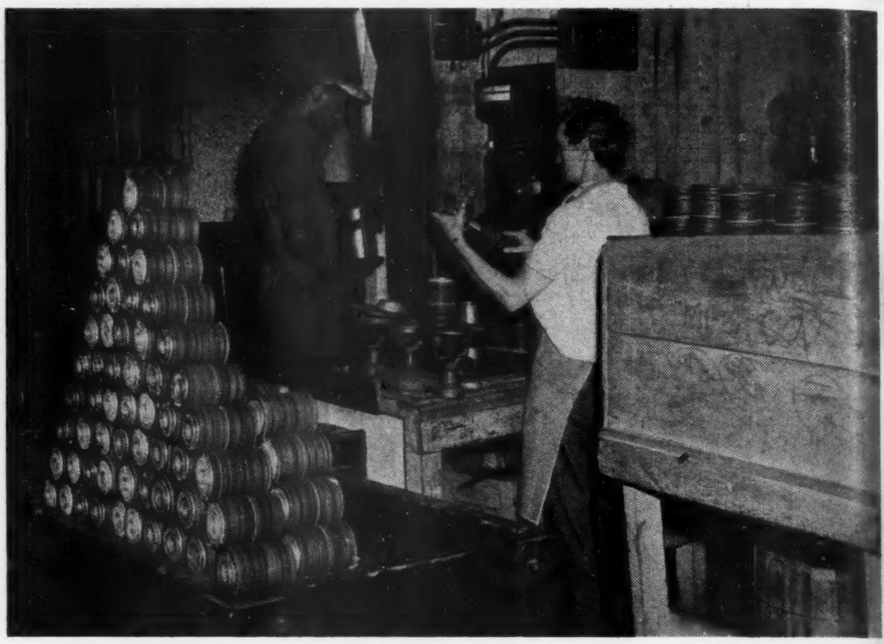
Pulleys less than 5½-6½ inches in diameter, as well as some of larger size intended for special purposes such as idlers, are made by the die-casting method. For this type the rings are not fastened together with glue and dowels but are held instead by a metal hub and ends cast about the assembly. This is more economical than the hydraulic method when pulleys of a certain size are to be produced in quantity. In this connection it is interesting to note that the basic patents for the die-casting of paper pulleys and for the casting of metal on fibrous material originated with Rockwood.

The die-casting division of the plant is a separate department and turns out finished pulleys. There paper rings are assembled with their holes in line, as already described. After the thickness of each stack has been checked by a gauging machine the multiple rings are encased in a metal shell and put in the die-casting machine, where a pressure of 300 psi.—the same as that exerted during gauging—is applied to each end of the stack. Molten metal under a pressure of 390 psi. is then introduced, forming the hub or shaft sleeve, ends, and ties or metal rods extending through the holes in the rings.

When the die-cast pulley is cool, the bore is broached and finished to an oversize tolerance of 0.002 inch, the ends are trimmed, holes for setscrews are drilled, and a keyway is cut, if necessary. Next, it is turned on a lathe, checked for balance, and counterweighted, if needed. Pulleys intended for use as textile rolls, which must have a smooth surface to prevent the thread from catching, are ground to a mirrorlike finish. The others are dipped in road oil and given a protective coating of lacquer.

Pulleys for shipment to manufacturers of farm machinery and other equipment are crated in large lots and loaded into railway cars that are run right into the shipping department. Others are packed in individual cartons. Pulleys up to 14 inches in diameter and 13 inches in width are carried in stock in the warehouse, a total of 2664 different types and sizes being available within this classification. Special kinds are made to specifications.

Until a comparatively few years ago, paper pulleys were used indoors wellnigh exclusively because it was believed that they would deteriorate upon exposure to rain and snow. Mechanization of farm work, however, has created a demand for an outdoor type that would stand up under all climatic conditions. After some experimenting, Rockwood found that a paper pulley saturated with oil was proof against even the worst weather. This type is being used increasingly for farm machinery, sawmills, and other outdoor equipment.



DIE CASTING

Pulleys less than 5½-6½ inches in diameter are generally made by the die-casting method. Molten zinc-alloy is cast around an assembly of paper rings by the machine shown in the background, the metal forming the ends and hubs of the pulleys. They are turned to size and finished in the same manner as those produced by the hydraulic method.

Besides paper pulleys, Rockwood manufactures several associated products such as friction drives—pulleys that turn machinery by direct contact with a flywheel or other driving mechanism. These are made from tarred and rawhide grades of paper in the same way as are paper pulleys. Sheaves for V-belts also are cast, cleaned, and rough-ground in the foundry and bored, milled, and grooved in the machine shop. The company recently installed a number of large, automatic machines for their production, and now offers a complete line of V-belt sheaves.

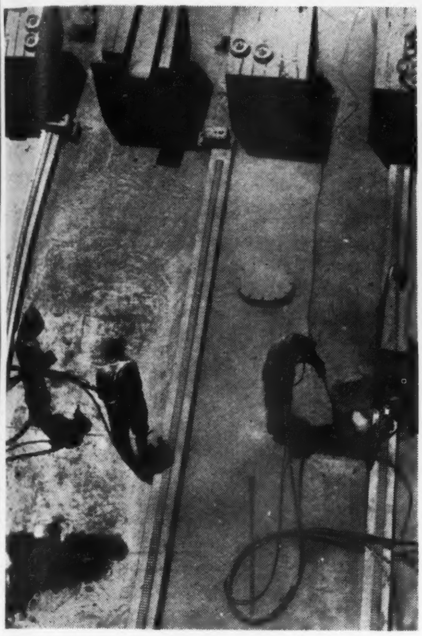
Still another important product is the Rockwood base which features a pivoted platform on which a motor rests. The pivot point is so located that the motor's weight causes it to tilt away from the machine it is driving, thus keeping the belt between the two stretched tight. The platform is free to move in response to changes not only in belt tension caused by different motor speeds but also in load put on the machine. As the load increases and decreases, the base automatically tightens and slackens the belt so that it is always under proper tension. Further, because the motor bearings are under less pressure than when the unit is rigidly bolted to a foundation there are fewer cases of burned-out bearings.

The old adage that "Necessity is the mother of invention" was never exemplified more fully than in the case of William Rockwood and his pulley fashioned from paper and broomsticks that proved equal to the task imposed upon it. A service record of more than 60 years since that makeshift was put to emergency use has fully earned for the paper pulley the manufacturer's slogan: "Pulleys that Pull."

ASSEMBLING MOTOR BASES

Rockwood builds pivoted motor bases in sizes ranging from small ones for fractional-horsepower motors to units big enough for a 300-hp. motor weighing 30,000 pounds. Those pictured are intended for ice machines, compressors, pumps, stokers, etc., that require small driving units. The parts that make up the bases are cast in the foundry or turned out in the machine shop, and are then brought together for assembling. The workman is running nuts on bolts with an Ingersoll-Rand 4U rotary-impact tool. Another aid in this department is an air-operated grinder that is used to remove irregularities from castings.

Rehabilitating a Dry Dock



WORK IN PROGRESS

The haze in the picture above was caused by sandblasting outfits that were used to remove old paint and rust from the interior and exterior surfaces of the dry dock preparatory to refinishing them with fresh protective coatings applied by spray guns. At the left is a close view of a group of sandblasters.

IT IS a noteworthy fact that more vessels of the United States Navy have been put out of operation by the chemical action of salt water than by enemy acts of aggression. Consequently, naval officers now spend almost as much time in determining the best methods of combating corrosion as they do in planning armaments and battle-winning tactics.

Generally speaking, the fight against corrosion consists in finding protective paints that have maximum resistance to salt water and in providing means for refinishing the ships as soon as those coatings begin to deteriorate. In many cases, the work is accomplished in a dry dock, which is flooded to receive a vessel and then sealed and pumped out. It is a tedious process, because old paint and rust must be removed before the new viscous coatings can be put on and because it has been the practice in the past to apply them manually. But even so, it is still more tedious to refinish a floating dry dock.

First, the dock must be sailed into comparatively shallow waters. Then the watertight bulkheads on the two sides must be alternately filled with water to cause the structure to list first to one side and then the other to permit workers to clean and recoat those areas that are normally below the water line. Yet, despite the added difficulties of "rehabilitation," technicians of the Industrial Maintenance & Engineering Company of Los Angeles, Calif., have developed methods that are dependent upon an extensive use of compressed air and whereby the job can be done in less time than it previously took to refinish a smaller ship in a dry dock. They were planned especially for the *YFD-68*, an electrically controlled dry dock with a capacity of 14,000 tons, but will no doubt be generally employed in the future for operations of this kind.

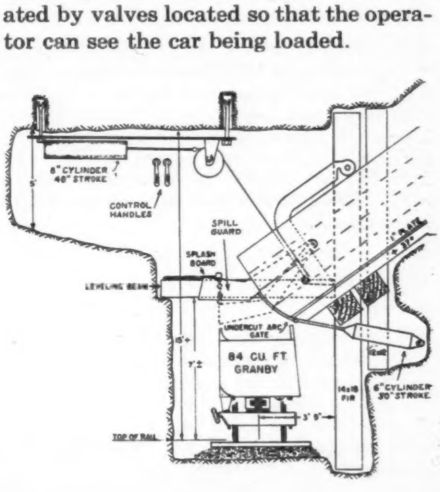
The initial phase of the work on the *YFD-68* consisted in cleaning all metal surfaces with sandblasting equipment, the power of which was sufficient to obviate the need of manual scraping. Then the structure was primed and finished by spray coating. The latter operations were unusual, according to naval officials, because it was heretofore believed to be impossible to spray materials such as Bitumastic 50 and Saf-T-Coat, two of the most viscous compounds now specified by the Navy.

It is estimated that sandblasting and spray-painting together reduced the man-hours on the *YFD-68* to less than half the number that would otherwise have been required to refinish her surface of 528x128 square feet. The entire job was done alongside a Consolidated Shipyards pier at Wilmington, Calif., by 25 men.

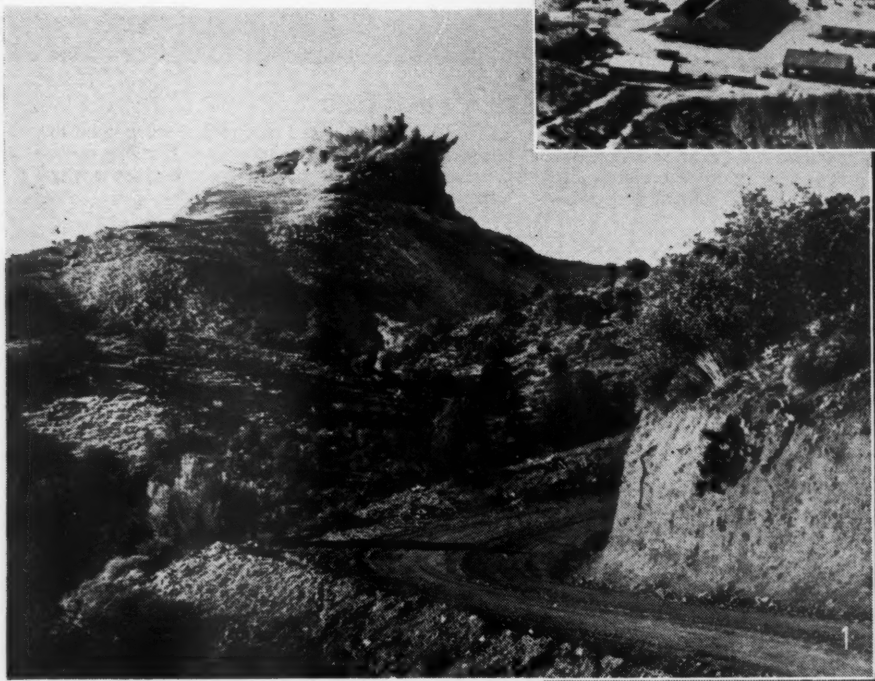
Air-Operated Chute Gate

AT THE Holden Mine of the Howe Sound Company at Holden, Wash., mine cars are loaded with ore by means of standard chutes equipped with air-operated gates. The gates were developed by the company and, though designed for the handling of large quantities of coarse muck, still enable the operator closely to control the amount withdrawn. The chute is constructed of heavy timber, and the bottom is lined with 1-inch strips of mild steel that last as long as the chute itself.

The main gate is made up of four 1600-pound fingers in a single assembly hinged above the chute. It is raised by an 8-inch-diameter pneumatic cylinder having a 40-inch stroke and controls the major portion of the broken material. Closure is effected by gravity. An arc-shaped undercut gate mounted on the end of the chute regulates the lesser quantities of fines that escape through the main gate. It is opened or shut by a double-acting, 6-inch air cylinder having a 30-inch stroke. A spill guard, hinged to the sides of the chute, rests on the undercut gate and, as the latter is lowered, swings down to rest on the far side of a Granby-type car. This prevents excessive spillage in loading. The pneumatic cylinders of both gates are actuated by valves located so that the operator can see the car being loaded.



Castle Dome Copper



1 The initial blast that shattered the cap of Castle Dome and marked the start of stripping operations in January, 1942. Nearly fourteen million tons of overburden had to be removed before actual mining and milling of ore could begin.

2 This April, 1943, picture shows the effects on the dome of fifteen months of mining. The ore is removed in a series of benches 45 feet high and averaging 800 feet in length. Dynamite placed in drilled holes breaks the ore for loading by 5-cubic-yard electric shovels into 30-ton trucks for transportation to the mill. The mine offices and shops are in the foreground.

3 This underground Allis-Chalmers primary crusher, driven by a Westinghouse 300-hp. motor, reduces the ore to a size that can be easily handled by the secondary crusher. Trucks arriving from the mine dump the ore into a hopper, from which it is delivered to the crusher by a pan feeder.

4 Mill of the Castle Dome Copper Company. From the primary crusher, located underground at the left, the ore travels 2350 feet on an inclined overhead belt conveyor to the secondary crusher, where it is further reduced in size. The material next goes to ball mills for fine grinding, then to flotation cells in the building at the left. Mill tailings are sent to Dorr thickeners (far right), where precious water is recovered for reuse.

5 Finely ground ore discharged from the ball mills is mixed with water and oil, then agitated in flotation cells. Bubbles of air released near the bottoms of the cells travel upward through the slurry, collecting tiny particles of copper compounds and carrying them to the top, where they are removed with the froth produced through agitation. This product is shipped to a Miami smelter for recovery of the copper content. Air for operating the flotation cells is provided by the four Ingersoll-Rand centrifugal blowers pictured. Each is driven by a Westinghouse 400-hp. motor. The four machines will deliver 112,000 cfm. of air at $2\frac{1}{4}$ psi. pressure.

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THE war is not over so far as copper is concerned, for the metal is now in greater demand than it was during the conflict. Production troubles at the mines, continuing military needs, and an unprecedented postwar industrial demand have converted the United States from its prewar status of copper exporter to one of the world's largest importers of the red metal.

In 1947 our consumption of copper was more than double the average annual use of 720,000 tons during the 5-year period 1935-39. To satisfy the demand, we are now reconverting from scrap about as much metal each year as our mines are producing. Following removal in 1946 of the 12-cent-a-pound ceiling price in effect during the war, the free-market quotation rose steadily and the current price is $23\frac{1}{2}$ cents.

Among the newer domestic sources now adding important tonnages to the nation's available supply is the Castle Dome of the Miami Copper Company near Miami, Ariz. It was developed from a deposit that was known for more than 75 years but was never before brought into production. In 1941, the owners of the open-pit mine explored the ore body with a view to adding it to the company reserves. When the war broke out, however, it was decided to exploit it, and a subsidiary—the Castle Dome Copper Company—was formed for the purpose. Under arrangements made with the Defense Plant Corporation, mine development and mill construction were begun in January, 1942, and milling was started in June, 1943. The average annual output since then has been four million tons of 0.74 percent copper ore that has yielded more than 48 million pounds of copper.

Editorials

THE QUEST FOR URANIUM

SOMETHING more than a mild flurry of excitement over uranium is sending prospectors into the hinterlands of the earth. As an object of search, the atomic-energy metal is replacing gold which, though still wanted by everyone, yields little or no profit to the miner under the fixed selling price that has not changed since 1933 when low production costs prevailed. For several reasons, the hunt for uranium is particularly keen in Canada.

Mining is an important segment of the Dominion's economy and, with large areas yet to be explored, is still in the ascendancy. Such a mineral-conscious nation is naturally well supplied with experienced prospectors. Finally, in the Eldorado Mine, she possesses the richest uranium deposits known in the Western Hemisphere, and this prompts the thought that equally desirable ore may await discovery in the region.

Several noteworthy finds have already been made, chiefly in Saskatchewan, which is acclaiming itself as the "Uranium Province." The government of Saskatchewan fosters prospecting almost to the point of "grubstaking," and in this case at least the policy has paid off. Qualified searchers are flown free to and from selected areas; are loaned tents, canoes, certain prospecting equipment, maps, etc.; and receive geological advice and other benefits. They must purchase their own food in advance.

Prior to the war, uranium sold for 35 cents a pound and was used principally as a pigment in the ceramics industry. All that was needed was obtained as a by-product of vanadium mining. Now, however, to spur the quest for the mineral, a price of \$3.50 a pound for contained uranium oxide has been guaranteed in the United States for a period of years, and essentially the same terms prevail in Canada.

From the miner's standpoint, uranium production holds forth alluring possibilities if ore of the pitchblende type can be located. A Canadian engineer has calculated that a ⅛-inch stringer of it with a uranium-oxide content of 60 percent would yield ore worth \$37.75 a ton. This figure is based on a width of 30 inches, which is about the minimum space in which work can be conducted. On the same basis, a ½-inch vein would yield \$150 ore, and a 1-inch streak would be valued at \$300 a ton. Allowing for a maximum shrinkage of 20 percent during concentration, these amounts look big in contrast with the returns from gold mining, where ore that runs \$20 to the ton is considered high grade.

The chances of making worth-while pitchblende discoveries are much more remote in the United States than in Canada. Our principal hope lies in the low-grade carnotite deposits of Colorado that were once mined for radium and are currently yielding vanadium. Production from mines so far developed comes from occurrences that were visible in eroded valleys. There is reason to believe that they persist in a fairly wide area under an overburden of varying thickness. Prospecting there is a job for diamond drills, and the Atomic Energy Commission has arranged with the U. S. Geological Survey to put down several hundred thousand feet of hole a year.

Meanwhile, Government experts have scotched the report that uranium is so scarce that the supply will be exhausted in a matter of 30 or 40 years. Actually, they say, there is probably a thousand times more uranium than gold in the earth's crust, and it may be more plentiful than lead or zinc. This is not tantamount to saying that many bodies of high concentration will be located. The metal can, however, be recovered in small amounts as a by-product from numerous sources. Sweden is getting it from oil shales, and plans are being made to save the small quantities that are known to exist in the gold ores of South Africa.

DRILLING DEEP FOR OIL

THE first article in this issue calls attention to the increasing depth of oil wells and to the effect of this trend on the modification of drilling equipment and procedure. Measured by today's standards, a "deep" well is one of 10,000 feet and more. One fifth of the 38,650 wells drilled in the United States last year were carried below 5000 feet and 132 below 12,000 feet.

Deep drilling requires large, expensive rigs that not only put a heavy capital-investment charge on each venture but, naturally, also cost more to operate than smaller equipment. Furthermore, the deeper a well goes, the more it costs per foot; and at great depths the increase is at a rather precipitate rate. For example, one can put down three 10,000-foot wells for the amount needed to drill a 15,000-foot hole. According to *The Lamp*, published by the Standard Oil Company (New Jersey), the average 12,000-foot well represents an expenditure of \$363,000. The reason for substituting fast-acting, untiring power for muscular effort wherever that is possible is obvious.

In Texas, which has 100,000 wells that produce twice as much oil per day as any entire nation other than the United States, an average of 130 bits is worn out in putting down a 12,000-foot well. In California, where rock conditions are more severe, the number may reach 183. Every time a bit is changed, all the drill pipe in the hole has to be withdrawn, disjointed, and stacked. After a new one has been put on, the procedure is repeated in reverse order. In a deep well such a round trip, as it is called, takes place many additional times between bit changes in order that geologists may obtain information on bottom-of-hole conditions. Every cycle in and out of the hole consumes a lot of time which, in the case of a 12,000-foot well, can be translated into money at the rate of about \$1000 a day. A few minutes saved here and there by mechanizing operations that have traditionally been performed by the exertion of human energy, multiply into many hours and huge sums of money in the case of each such well.

Deep drilling was inaugurated around 1942 when the war's insatiable appetite for petroleum products demanded an increase in our national crude output. In west Texas, which had many shallow wells, bits began to probe formations 8,000, 10,000, and even close to 12,000 feet below the surface. Deep drilling then spread to other areas. In Wyoming, where the first yield was from a depth of around 1300 feet, a commercial well was brought in last year at 14,300 feet. It currently holds the depth record for producers, although a nonproductive "wildcat" has gone down 17,832 feet. Sedimentary formations that may contain oil are known to lie 20,000 feet beneath the surface in places, and drills will no doubt explore them eventually.

Although cable-type tools, with which the oil industry started, are still much used in shallow drilling, deep wells are all put down with rotary rigs. The old-time driller controlled his tools by their "feel," and he did a good job. But he can't sense the action of a bit 2 miles or more underground. At a depth of 10,000 feet, the drill pipe that serves to rotate the bit at the bottom may turn or wind up eight revolutions at the top before the twisting action is imparted to the lower end, and it may stretch as much as 5 feet under its own weight. This behavior of the steel column obviously has a deadening effect on human perceptions. To control the weight on the bit, a new electronic device has just been introduced. It makes use of a strain-gauge assembly, an electric potentiometer that indicates the weight, and a pneumatic brake that maintains the desired pressure.

Most oil-well drilling is done by specialists, which is evidenced by the fact that 83 percent of the rotary rigs in the country are owned and operated by 500 private contractors. The larger oil-producing companies have drilling departments to put down a few of their wells mainly for the purpose of determining costs as a guide in letting contracts and

also to permit them to conduct research aimed at improving equipment and techniques. The high cost of deep drilling has intensified these investigations, and Humble Oil & Refining Company technicians have been operating an experimental rig for more than a year with the intention of eventually making it function virtually automatically. More than 30 devices of one kind or another have been incorporated in it, and many of them are air-operated.

Meanwhile, drill-rig manufacturers and suppliers of component parts have been conducting their own researches. As a result of this combination of efforts, ways and means of drilling oil wells economically and in the shortest possible time despite the problems imposed by increasing depth are being developed and will crystallize shortly into standard practice. As our article points out, air power offers the best solution for many of the operations involved, and it is a safe conclusion that a sizable air compressor will be an indispensable part of every rig in the future.

This and That

Skyway Builder Retires

At the beginning of the year Sigvald Johannesson retired as chief of the New Jersey State Highway Department's bureau of planning and economics. He is known primarily as the designer of the Pulaski Skyway, a $20,000,000 elevated roadway that carries traffic several miles across northeastern New Jersey to and from the Holland Tunnel. Mr. Johannesson developed a method of shifting sections of concrete highway sidwise with air pressure during widening operations. A description of its use in moving 400 tons of slabs on the main route between New York and Philadelphia was published in our December, 1935, issue.

* * *

Bessemer Converter History

Writing in *U. S. Steel News*, Alan F. Bessemer, now an American resident, presents the highlights in the life of his great granduncle, Sir Henry Bessemer, for whom the Bessemer converter is named. Noteworthy is the credit he gives William Kelly of the Cambria Iron Works in Pennsylvania for having been the first to discover the pneumatic process of steel making exemplified by the converter. Bessemer's work on the process grew out of his interest in cannon during the Crimean War of 1854-56. Having designed a rifled barrel that fired a revolving projectile, he sought to improve upon the grade of cast iron for it. The result of his investigations was a method of making steel by blowing air through molten iron. Bessemer not only built a converter but also the machinery for providing the air blast and must therefore be ranked among the pioneer inventors of air-compressing equipment.

Bessemer demonstrated his process before England's ironmasters and read a paper on the subject before the Royal Society in 1856. It was not at first commercially successful in all cases because of variations in the composition of the ores used in different plants. The steel frequently contained excessive amounts of oxygen or other gases. This difficulty was overcome by adding spiegeleisen—an iron containing relatively large amounts of manganese and carbon—at the end of the blow. Robert Mushet, an Englishman, apparently contributed this idea, although Bessemer contested the validity of the patent granted him. The controversy was ended when Bessemer bought the patent rights.

Three months after Bessemer had applied for an American patent on his converter, Kelly filed claims on his own creation and challenged the former's right to priority. Kelly was able to prove that he had worked on the process since 1846, or ten years before Bessemer's approach to the problem. However, patents on both converters were recognized in this country, and neither could be used without infringing on the other. Alexander Holley and a group of Troy, N. Y., ironmasters acquired the rights to the Bessemer process, while the Kelly Pneumatic Process of Wyandotte, Mich., controlled Kelly's and also Mushet's recarburizing method. The conflict thus set up was resolved when Holley formed a company to consolidate the patents of the opposing interests. This step paved the way for the unrestricted use of converters by American steel plants.

The article referred to also deals with Bessemer's diversified inventions. At the age of seventeen he left his home at Hitchin, England, to make his mark in London so that he could marry the girl of his choice. There his active mind soon began to assert itself. Having worked in his father's foundry he started reproducing Napoleonic medals in soft metals. He was diverted from this enterprise when he learned that the British Treasury was losing $400,000 a year because of the reuse of documentary stamps. He suggested perforating each stamp with the date of use, and while the government accepted his idea it didn't pay him for it. Undismayed, he developed a way of compressing graphite into slender rods for lead pencils. This cost much less than the prevailing method of sawing solid graphite into strips. Young Bessemer established a factory that operated secretly and paid him a handsome income for 40 years. This enabled him to turn his attention to other inventions, which added to his fortune. All told, 1500 patents were credited to him, and he received many honors, including knighthood for the stamp-perforating idea that brought him no money.

Men in the News

Death recently claimed two men who had much to do in past years with endeavors in which compressed air played a part. In mid-February, death came to Kirk Brown of Montclair, N. J., and William Young of Manhasset, N. Y. Mr. Brown, who helped found the Bakelite Corporation, also was among the organizers of the Century Wheelman Club composed of bicycle enthusiasts. One of the first of them to use pneumatic tires, he formed the American company to make tires by the process originated by J. B. Dunlop in England.

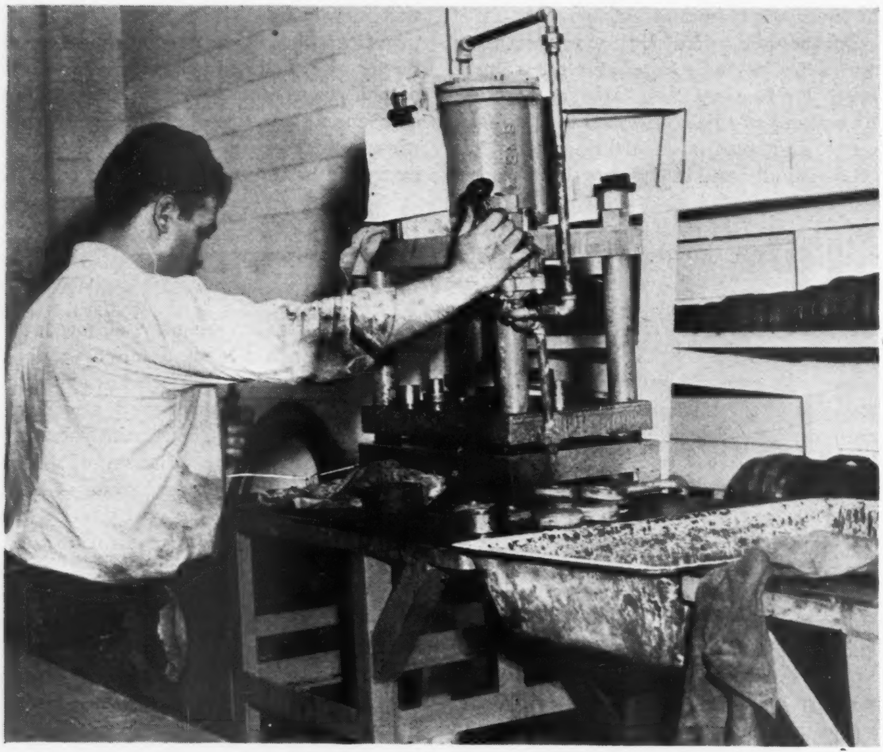
Mr. Young founded his own construction firm before the turn of the century and directed it until his death. As a young man he helped to erect the steel for Grant's Tomb in New York City. He converted famous Castle Garden, at the tip of Manhattan Island, into the Aquarium that was visited by millions until it was recently vacated to facilitate work on the Brooklyn-Battery vehicular tunnel. He constructed many of New York's bank buildings and also the old gold-front Edison Building.

* * *

Problem of Water Pollution

Startling statistics on water pollution in New York State were quoted recently by Assemblyman Harold C. Ostertag in warning a gathering of engineers and other interested persons that safe, clean water will be but a memory unless corrective measures are taken. Mr. Ostertag declared that every watershed in the state is contaminated by sewage and industrial wastes, which amount to more than a billion gallons ever 24 hours. Raw sewage from 115 municipalities with a total population of 4,726,000, plus corrosive or putrid wastes from thousands of industries, are discharged into the streams, he claimed. "Pollution abatement is either everybody's job or nobody's job," he said. "Unless we take steps now to check and eliminate the burden of pollution that threatens our water, New York State will have lost its greatest basic resource." Mr. Ostertag is chairman of the New York Joint Legislative Committee on Interstate Cooperation.

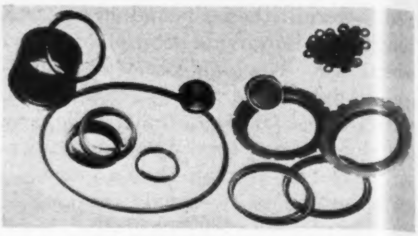
Producing Precision Packings



IN THE manufacture of packings for "pneudraulic" and related types of machinery, it has long been a problem how to fabricate rigid leather packings that will meet dimensional specifications requiring extremely small tolerances without greatly increasing production costs. Generally speaking, efforts to solve the difficulty from the cost standpoint have been unsuccessful because it has been the practice to manufacture packings of that kind by the same processes by which flexible and semiflexible packings are made. These, for obvious reasons, do not call for dimensional accuracy.

The use of nonprecision production methods has been expensive because rejections have been high in order to maintain the desired quality. It could be justified only on the grounds that precision molding of leather products was impractical. But now, both engineering and manufacturing data have proved that assumption to be unfounded. By a new process, based on what may be described as a combination of plastic and metal fabrication principles, virtually all types of rigid leather packings are being made in accordance with exacting dimensional specifications at a cost that compares favorably with that of other kinds of packings.

Careful control of leather processing prior to and during compression molding is essential. The object is to minimize the number of dimensional variations left after molding and to eliminate the sort of machine-finishing work that rigid leather packings ordinarily need. Raw leather of the best quality is mandatory and must be stiffened to the right degree by treatment with accurately regulated quantities of waxes of specified kinds. This insures uniform molding properties.



PRESS AND PACKINGS

At the left is shown a 2-ton, air-operated press in which rigid leather packings are molded in the plant of the Searle Leather & Packing Company, Los Angeles, Calif. Specimens of the varied sizes and shapes of the product are illustrated above.

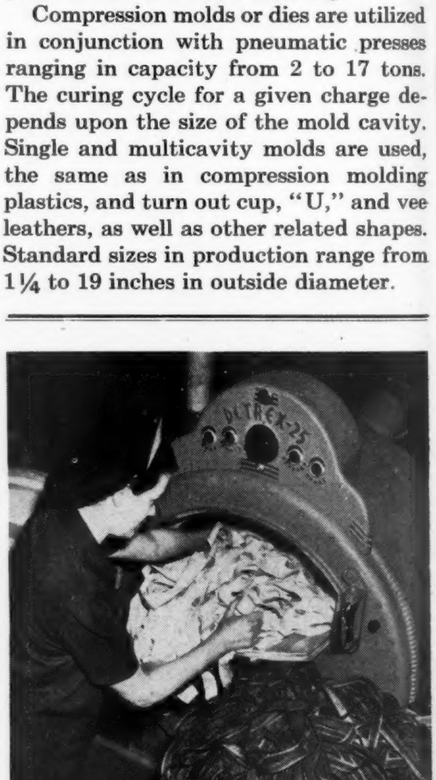
The raw materials are blanked with precision before molding, the purpose being to provide a mold charge that will completely fill the cavity of the steel die so there will be no excess material to become "flash" during the molding process. This, of course, calls for careful engineering and highly accurate tooling, but is justified on the score of fewer rejections and less lathe finishing.

Compression molds or dies are utilized in conjunction with pneumatic presses ranging in capacity from 2 to 17 tons. The curing cycle for a given charge depends upon the size of the mold cavity. Single and multicavity molds are used, the same as in compression molding plastics, and turn out cup, "U," and vee leathers, as well as other related shapes. Standard sizes in production range from 1¼ to 19 inches in outside diameter.

Self-Cleaning White Paint

WHAT is described as a self-cleaning paint has been developed by the British Railways, according to a recent issue of the London *Engineer*. It is a white, glossy, hard-surface paint for signal posts and its purpose is to prevent discoloration so the posts will remain clean and clearly visible. As a basis upon which to work in attempting to produce a coating of this kind, the research men took advantage of the characteristic of certain paints known in the industry as chalking; that is, the formation of a powdery residue that can be rubbed off and that rain washes off. As a new surface is exposed it, too, disintegrates, the process continuing until the entire film is gone.

Titanium dioxide was chosen because it is the one among modern white pigments that is known to chalk to a marked degree. Furthermore, it possesses qualities essential in a paint for signal posts, namely: it imparts a high gloss and insures a maximum degree of color retention as well as opacity that permits the application of a minimum number of coats. The problems facing the investigators were how to control chalking to give the paint the longest possible life and how to overcome discoloration caused by white lead. Both were finally solved by incorporating another pigment in place of the latter compound. What it is has not been divulged, but it is reported that the self-cleaning paint has served well for nearly six years.



DOES OWN DRY CLEANING

This girl in the Philadelphia plant of SKF Industries is handling cleaned polishing tape. Before it was treated it had looked like that in the lower pile. By cleaning soiled tape, work gloves, wiping cloth, etc., in its own establishment, SKF expects to save thousands of dollars a year and to get longer service from the materials.

Industrial Notes

For use in connection with heat exchangers and a wide range of hydraulic and other equipment, Rotometals, Inc., is offering zinc rods as a means of protecting them against corrosion. Known as Cor-In, they are fitted with standard pipe-plug ends and are available in lengths up to 12 inches and diameters ranging from 3/8 to 1 inch.

Leadfree paint is a recent product of Pittsburgh Plate Glass Company and is intended for use in industrial areas where the presence of sulphurous gases causes lead pigments to darken. The new coating is said to retain its color in such atmospheres and to be resistant to sunlight and salt water. It is suitable for covering wood, brick, and masonry surfaces.

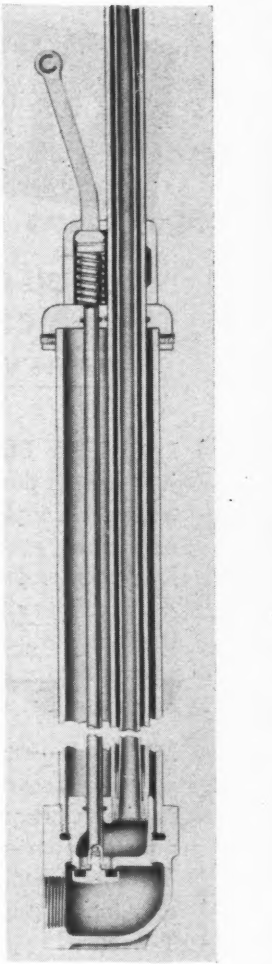
Plastic and textiles have been combined to form a material that is stronger than steel, according to the American Chemical Society. The plastic is of the polyester type, and among the textiles used are tire-cord rayon, nylon, Steralon (an unwoven cotton cloth), Fortisan (a synthetic-cellulose fiber), and woven glass fiber. The new material can be molded into many useful products including automobile bodies, pipes, and boat hulls.

Equipment that is said to permit complete and well-nigh simultaneous gauging of most critical dimensions and conditions of an automobile camshaft has been developed by The Sheffield Corporation. Six bearing diameters and two lengths are checked with Airsnaps—a snap-type gauging spindle—used in conjunction with a 5-column and a 3-column Precisionaire, a recording instrument that has been described several times in these pages. It has a freely moving float and supplies low-pressure air through short lengths of hose to jets or orifices in the Airsnaps. The shaft, which is shown in gauging position in the accompanying illustration, is revolved manually to check for out-of-roundness, as well as for concentricity of five bearings which is indicated by a variation in float position in another 3-column Precisionaire. Checking the two lengths is effected by additional air jets incorporated in two of the Airsnaps. Runout of the oil-pump drive gear is gauged by a separate unit consisting of a mating gear mounted on a ball slide and actuating a dial indicator. The relief hole is checked by introducing a stream of air, which the operator can feel if the passage is clear. Hardness is determined by a sclerescope while the camshaft is being gauged.

Scaffolding 125 feet high required in remodeling a department store in Seattle, Wash., was erected without the use of nails, spikes, and bolts. Instead, the Douglas fir 4x4 uprights, 2x6 ledgers, and 2x4 stringers were held together by brackets and 3-foot steel braces, a new type of connector called Knife-Grip. It comes in different sizes and is said to hold the scaffolding straight and level; to eliminate cross bracing; and to permit repeated use of the lumber because it is not damaged.

A soldering iron that is heated by "firing" a cartridge inserted in the copper tip of the tool has been developed by the Kemode Manufacturing Company. The cartridge, which is about the size of a small flashlight battery, contains a nonexplosive mixture of metal powders and an oxidizing agent, together with a primer. When the latter is struck a sharp blow by releasing a pointed spring rod at the end of the handle, the charge is ignited, heating the iron to a working temperature in five seconds and maintaining that heat for ten minutes, it is claimed. Iron has to be reloaded after each operation.

Outside surface connections to buried water mains need no longer present a problem in freezing weather, according to a recent announcement by the Crane Company. The latter has designed what is described as a deicing or frostproof hydrant, the basic features of which are a rubber-lined riser spout in which a rubber tube extends the full length of the hydrant to a point well below the frost line. A lever at the top operates the valve, which is of the composition disk type. When the latter is closed, the rubber tubing, which is installed under tension, has an internal diameter that is slightly larger than the thickness of a lead pencil. When opened, the pressure of the water expands the tube, bringing it in contact with the riser spout and allowing a full column of water to flow. In cold weather, the water in the contracted tube freezes down to the frost line, but as soon as the hydrant is turned on and the diameter of the tube is increased under the pressure of the flow, the "pencil" of ice is broken up and flushed out with the water. At the lower end of the lever is a cam which thrusts the valve stem downward when the handle is moved forward. When it is released, the valve disk is again seated under the combined pressure of the water and a spring. Underground pits, gravel boxes, drainage lines, insulating material, sump pumps, and electric heating coils are eliminated, and unit can be disassembled for repairs without digging it up. The standard hydrant is 5 1/2 feet long, which places the valve mechanism 4 feet beneath and the outlet 30 inches above the ground surface.



Windshields and windows made of a special glass named Electrapane are proof against fogging or icing, according to the Libbey-Owens-Ford Glass Company which developed the product for the Armed Forces. The distinctive feature of the glass is a transparent oxide film, 20-millionths of an inch thick, that enables it to carry an electric current.

Pressure vessels of exceptionally high strength are described in a report on Germany's hydrogenation plants as one of their outstanding developments. They are made of thin-walled tubes wound with metallic tape on lathes of the same type used in machining solid-walled vessels. Tape of either 5x50 or 8x80 millimeters is applied, and the thickness of the layer depends upon the size of the tube and the working pressure. The vessels are said to be strong enough to resist a maximum pressure of 4000 atmospheres, or 60,000 psi. A mimeo-

graphed copy of the 152-page report (PB-80349), titled *Engineering in Hydrogenation Plants in Germany*, costs $4.25 and can be obtained from the Office of Technical Services, Department of Commerce, Washington, D. C. It gives full details of the composition of the tape, its manufacture, and method of winding.

An improvement in electrically controlled air valves for direct or remote control of standard pneumatic cylinders has been announced by The Bellows Company. It consists of a cast-bronze body with a single air inlet and of a cylinder in which floats a lightweight

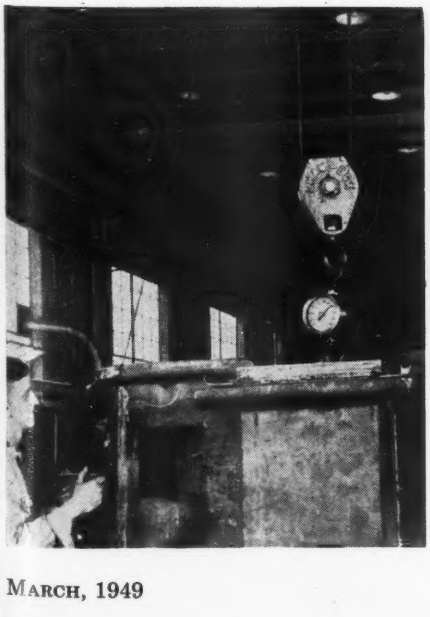
piston. The latter is cushioned at both ends and engages a 4-way shear-flow air valve. In the cylinder end caps are small 8-volt solenoids the plungers of which, though moving but $1/32$ inch, release the full pressure of the air in the supply line to drive the lightweight piston and thus shift the shear-flow valve in the direction desired. The valve has been tested under service conditions for more than a year and is said to operate at such high speed that the available clocking mechanism could not time it beyond 2200 movements per minute. Even so, the low-voltage solenoids develop little heat because of the cooling effect of the expanding air stream in which they lie. Further claims made for the device are that its use protects machines and their operators against flashover and that it will function when covered with coolant, chips, or dust. Valve is available in ¼- and ⅜-inch port sizes, complete with transformer. Small unit is not much larger than a pack of cigarettes.

To facilitate the work of stripping nonmetallic cable sheaths when making electrical connections, the National Electrical Products Corporation is marketing a new type of ripper through wholesale dealers. It consists of two

hinged parts: a rounded channel in which the cable is laid, and a top member with a rudder-shaped blade that is forced through the sheath when the two are clamped together. The tool is then pulled forward to slit the sheath, and is said to do the work without scoring the copper conductors. The ripper is made of case-hardened cadmium-plated steel and is suitable for both braided and tough plastic sheaths.

Stains and stresses in pipe lines under pressure or vacuum are relieved, it is claimed, by the use of rubber expansion joints, a new product of The Garlock Packing Company. They are made in a wide range of sizes and in three types: for operating pressures from 40 to 125 psi.; vacuum, 30 inches of mercury; and pressure and vacuum. A split, zinc-plated steel retaining ring is placed directly against the inner face of each of the rubber flanges to prevent damaging them when the bolts are tightened. Gaskets between joint and pipe flanges are not required. According to the manufacturer, the joints are resistant to hot and cold water, brine, and exhaust steam up to 180°F. Lined with synthetic rubber, they are suitable for pipes handling oils, acids, and mild caustic solutions.

Scales without moving parts such as springs or levers and designed for weighing heavy loads have been announced by Hydroway Scales, Inc. They are based on the "static-pressure principle" and are known by the name of Hydroscale. Permanently sealed and unaffected by temperature, they automatically scale loads as they are lifted and are said to make weighing a routine matter where that was not considered practicable heretofore. Accuracy to within one-half of one percent is claimed. The first scales built on the principle are 2-, 5-, and 10-ton units for cranes and chain hoists. Our picture shows a 2-ton model used in conjunction with an electric crane.



Industrial Literature

A bulletin covering its recently developed electric valve for the control of such equipment as single- and double-acting air cylinders, air-operated presses, etc., can be obtained from Hannifin Corporation, 1101 South Kilbourn Avenue, Chicago 24, Ill.

Air tools for plant maintenance is the subject of a new bulletin, Form 5053, obtainable from Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y. The bulletin tells how crews faced with a multitude of such jobs can do them in less time and at lower cost by using a compressor as the one source of power for all of them.

The Eastern Machine Screw Corporation, New Haven 6, Conn., has prepared in pamphlet form a digest of the American Standards Association publication B1.1—*Unified American Screw Threads for Screws Bolts, Nuts, and Other Threaded Parts*. It explains the most important points of the agreement recently reached by Canada, Great Britain, and the United States on uniform screw threads.

Van Products Company, 1502 Erie Trust Building, Erie, Pa., will send upon request information concerning three new models of a pneumatic vise manufactured by it. Designed as a production tool, the vise will handle anything from small pieces to large, unwieldy castings. An air-regulator valve permits varying the jaw pressure from 0 to 3½ tons for light or heavy work, and foot control leaves the operator's hands free.

Results of a comprehensive study of dust explosions in industry have been published in two volumes entitled *Handbook of Industrial Hazards from Explosive Dusts*. Written by W. H. Geck, German specialist in this field, the text is in German, with an abstract, foreword, and table of contents in English. The nature and composition of dust, its origin, and its ignition are analyzed, and particular attention is given to dust problems created by fiber materials in the textile industry. Conditions in spray-painting, woodworking, cork, and sugar plants are described; but flour, coal, and aluminum industries are not covered. Listed among the protective measures against the hazard are: control of the intensity of electric-light bulbs, properly designed suction systems, and adequate filters. Vol. 1 of 117 pages (PB 85197) and Vol. 2 of 165 pages (PB 85198) cost $3 and $4.25, respectively, and can be obtained from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Totally enclosed, fan-cooled motors in the larger horsepower ratings are the subject of a folder obtainable from Allis-Chalmers Manufacturing Company, South Seventieth Street, Milwaukee, Wis. Intended for outdoor use with power-plant auxiliaries, in oil fields and refineries, and for a wide range of industrial applications, the units are built for the removal of generated heat without exposing the electrical parts to harmful atmospheric conditions. A nest of tubes arranged circumferentially in the stator frame serves as an air-to-air heat exchanger. Outside air blown into the tubes by a shaft-mounted fan absorbs heat from the inside air, which is circulated around the tubes by a set of internally mounted fans. Squirrel-cage, wound-rotor, and synchronous types are available for either vertical or horizontal installation. Ratings range from 150 hp. at 1200 rpm. to several thousand hp. at standard speeds from 3600 to 300 rpm. They can be made explosionproof or equipped with noncorrosive fittings for installation in chemical plants.